REPORT RESUMES

ED 003 738 64
INSTRUMENTATION FOR INSTRUCTION, 1955-70, VOL. 1--TEXT.
BY- FINN, JAMES D. PERRIN, DONALD G.
NATIONAL EDUCATION ASSN., WASHINGTON, D.C.
REPORT NUMBER NDEA-VIIB-069-VOL-1 PUB DATE 60
EDRS PRICE MF-$0.27 HC-$5.84 146P.

DESCRIPTORS- *INSTRUCTIONAL TECHNOLOGY, *PROJECTION EQUIPMENT, EDUCATIONAL EQUIPMENT, *AUDIOVISUAL AIDS, FILMS, INSTRUCTIONAL FILMS, INSTRUMENTATION, DISTRICT OF COLUMBIA, TECHNOLOGICAL DEVELOPMENT PROJECT

THE ROLE OF EQUIPMENT IN THE NEW TECHNOLOGIES OF INSTRUCTION WAS EXPLORED. PROJECTION EQUIPMENT DEVELOPED SINCE 1955 AS WELL AS CONCEPTS OF PLANNING, FINANCING, AND ADMINISTRATION WERE DISCUSSED. EXAMPLES OF POST-1955 IMPROVEMENTS INCLUDED (1) INCREASED LIGHT OUTPUT DUE TO NEW LIGHT SOURCES AND IMPROVED OPTICS, (2) INCREASED EASE OF OPERATION AFFORDED BY ZOOM LENSES, AUTOMATIC THREADING, FILM CARTRIDGES, AUTOMATIC ADVANCE, AND REMOTE CONTROL, (3) IMPROVED PORTABILITY BECAUSE OF MINIATURIZATION, AND (4) IMPROVED DISPLAY TECHNIQUES SUCH AS INDIVIDUAL DESK-TOP PROJECTORS. OTHER VOLUMES IN THIS SERIES ARE ED 003 738 THROUGH ED 003 746. (LP)

B-069 ?
Vol

U. S. DEPARTMENT OF HEALTH, EDUCATION AND WELFARE
Office of Education
This document has been reproduced exactly as received from the person or organization originating it. Points of view or opinions stated do not necessarily represent official Office of Education position or policy.

FINAL REPORT

INSTRUMENTATION FOR INSTRUCTION

1955 - 1970

by

James D. Finn and
Donald G. Perrin

ED 003738

INSTRUMENTATION FOR INSTRUCTION: 1955-1970

FOREWORD

I. THE NEW TECHNOLOGIES OF INSTRUCTION

II. SOME CONSIDERATIONS CONCERNING INSTRUCTIONAL TECHNOLOGY

- A. The Impact of Technology
- B. The Characteristics of Media
- C. The Design of Instructional Systems
- D. Equipment Functions
    - 1. Display
    - 2. Storage of Information
    - 3. Transmission
    - 4. Duplicating
    - 5. Information Processing
- E. Trends in Modern Equipment
    - 1. Reliability and Performance
    - 2. Engineering Standards
    - 3. Human Engineering
    - 4. Flexibility
    - 5. Miniaturization
    - 6. Special Purpose Units
    - 7. Individual Learning
    - 8. Group Systems
- F. The Impact of Technology on the Classroom

Summary

III. OPTICAL PROJECTION EQUIPMENT

- A. Introduction
    - 1. Purpose
    - 2. History
        - a. Opaque Projector
        - b. Lantern-Slide Projector
        - c. Slide-Filmstrip Projector
        - d. Overhead Projector
        - e. Motion Picture Projector
- B. Trends and Developments Since 1955
    - 1. Increased Light Output
        - a. New Light Sources
        - b. Improved Optics
    - 2. Ease of Operation
        - a. Zoom Lenses

- b. Automatic Threading
- c. Film Cartridge
    - (1) Reel-to-Reel
    - (2) Flip-Over
    - (3) Continuous Loop Attachments
    - (4) Continuous Loop, Self-Threading
- d. Automatic Advance
- e. Remote Control

3. Portable Rear Projection Units
    - a. Daylight Projection Units
    - b. Multi-Purpose Units
4. More Flexible Display Methods
    - a. Polarized Light Effects
    - b. Synchronized Sound
5. Special Purpose Units
    - a. Time and Motion Study Projectors
    - b. Random Access
    - c. Controlled Reading Devices
6. Desk Top Projectors for Individual Learning
    - a. Individual Viewing Devices
    - b. Individual Sound Viewers
7. Miniaturization
    - a. Transistorized Amplifiers
    - b. 8mm and 16mm Filmstrips
    - c. 8mm Sound Motion Picture Projectors
8. Multiple Screen Presentation

C. 1963-1970: A Look into the Future
    1. Optics
    2. New Uses
    3. 3-D Processes
    4. Controlled Readers
    5. Individual Study Booths
    6. Automation
    7. Rear Screens

IV. SOUND EQUIPMENT

A. Introduction
    1. Purpose
    2. History
        - a. Radio
        - b. Record Players
        - c. Tape Recorders
        - d. FM Radio
        - e. Public Address Systems
        - f. Intercom
        - g. Telephones
        - h. Sound and Pictures

B. Trends and Developments Since 1955
    1. Listening Corners
    2. Tape Recorders
        - a. Tape Cartridges

(1) Reel-to-Reel
(2) Continuous Loop Cartridges
b. Magnetic Card Devices
c. Special Tape Recorders for Language Teaching
3. Electronic Learning Laboratories
a. Audio Passive
b. Audio Active
c. Audio Active-Comparative
d. Individual Study Booths
e. Automated Laboratories
f. Dial-in Systems
g. Wireless Language Labs
h. Battery Operated Recorders
i. Audiovisual Language Labs
j. Portable Trailer Labs
k. Some General Comments
(1) Transistors
(2) Modular Construction
(3) Tape Cartridges
C. 1963-1970: A Look into the Future
1. Random Access
2. Stereophonic Sound
3. Telephone Amplifiers and Recorders

V. EDUCATIONAL TELEVISION

A. Introduction
1. Purpose
a. Direct Teaching
b. Supplemental Teaching
c. Enrichment
d. Observation
2. History
B. Trends and Developments Since 1955
1. Closed Circuit Television
a. Single Camera - Teacher Controlled
b. Single Camera - Independent Control
c. Multiple Camera - Teacher Controlled
d. The Classroom-Studio
e. The ETV Studio
2. Broadcast ETV
a. Broadcast ETV Networks
b. Low Power Translators
c. Community Antenna Television
d. Midwest Program on Airborne Television
3. Television Equipment
a. Vidicon Cameras for Closed Circuit Operation
b. Television Receivers
c. Television Projectors
d. Television Recorders
e. Two-Way Communication
f. Color Television

- g. Three-Dimensional Television
- h. Library Television
- i. Special Equipment
- C. 1963-1970: A Look into the Future

VI. PHOTO-MECHANICAL COPY PROCESSES

- A. Duplicators for School Use
- B. Office Copiers
- C. Instant Photography
- D. Micro-Copying
- E. New Storage and Duplication Media
- F. Teletype and Facsimile
- G. Future Developments

VII. NEWER TECHNOLOGIES OF TESTING AND TEST SCORING

- A. Introduction
  - 1. Purpose
  - 2. History
- B. Trends and Developments Since 1955
  - 1. The Test Scoring Machine
  - 2. Group Response Systems
  - 3. Individual Response Devices
- C. 1963-1970: A Look into the Future

VIII. PROGRAMED LEARNING AND TEACHING MACHINES

- A. Introduction
  - 1. Purpose
  - 2. History
- B. Trends and Developments Since 1955
  - 1. Philosophies of Programing
    - a. Skinner
    - b. Pressey
    - c. Crowder
    - d. Gilbert
    - e. Center for Programed Instruction
  - 2. The Problems of Hardware
    - a. Text Formats
    - b. Masking Devices
    - c. Flash Cards
    - d. Teaching Machines
  - 3. General Purpose Teaching Machines
    - a. Skinnerian Devices
      - (1) Paper Programs
      - (2) Film Programs
    - b. Presserian Devices
      - (1) Electronic Punchboards
      - (2) Card Sorters
      - (3) Paper Programs

(4) Film Programs
(5) Some Additional Types
c. Crowderian Devices
d. Verbal Response
e. Group Response Systems
4. Special Purpose Teaching Machines
C. 1963-1970: A Look into the Future

IX. COMPUTERS AND AUTOMATION

A. Introduction
1. Purpose
2. History
3. Functional Units of the Computer
B. Trends and Developments Since 1955
1. General Purpose Digital Computers
2. Special Purpose Digital Computers
3. Programing and Computer Language
a. Input Devices
(1) Graphic Inputs
(2) Optical Scanners
(3) Sound Inputs
(4) The Sense of Touch
b. Output Devices
(1) X-Y Plotters
(2) Electroluminescent Displays
(3) Large Screen Displays
(4) Three-Dimensional Displays
(5) Sound Generators
(6) Automation
4. Data Processing Capabilities
a. Business Operations
(1) Mathematical Computation
(2) Symbol Manipulation
b. Mechanical Translation
c. Automatic Abstracting
d. Information Storage and Retrieval
(1) Indexing and Classification
(2) Storage
(3) Searching
(4) Retrieval
(5) Selection
(6) Future Developments

X. GAMING AND SIMULATION

A. Gaming
B. Simulation
C. Psychological Simulation

XI. THE SCHOOL OF THE FUTURE: A SUMMARY

ADD DISCLAIMER THAT INCLUSION OF EQUIPMENT IS NOT NECESSARILY A RECOMMENDATION, AND THAT NO EVALUATION OF INDIVIDUAL EQUIPMENTS IS WITHIN THE SCOPE OF THIS STUDY

CHAPTER I

THE NEW TECHNOLOGIES OF INSTRUCTION

This monograph deals primarily with equipment--instructional equipment--and is limited to recent developments, some of which have yet to be tried out in a school or college situation. It is intended to inform the planners of new schools and instructional systems as to what is just around the corner, and to provide school teachers, principals, and administrators with a picture of present trends.

Because the picture of technological change, even when limited to instruction, is a vast and changing one, it demands the immediate and constant attention of those who teach and those who must plan for the future.

It should be noted that technology does not involve equipment alone. Indeed, many applications of technology are not associated with any form of equipment. Technology is simply a means of problem-solving, of engineering solutions to currently existing problems.

The dilemma of modern education has been stated in terms of two explosions, the explosion of knowledge and the explosion of population. The number of human teachers is inadequate to teach the growing volume of subject matter to more children in the same amount of time previously required. Technology seeks realistic rather than idealistic solutions to this problem. If we cannot get more qualified teachers--and we will be short 250,000 qualified teachers by 1965 according to estimates of the National Education Association--we must make fuller use of the talent available. This involves new methods of organization such as the Trump plan, where classes are made larger for lecture presentations so that some teachers will be free to tutor smaller class groups. Other innovations include the packaging of resource materials for a given lesson, including records, filmstrips, workbooks, and study guides. Whole series of motion pictures, such as the Harvey White films in physics and chemistry, provide a new kind of resource to enrich the classroom experiences, and can take over the teaching in situations where these subjects could not otherwise be taught. Technology often includes equipment to overcome the logistic problems of duplication, storage, and presentation of materials--projection devices, listening units, television, language laboratories, and teaching machines.

In an age where we cannot travel to work or cook a meal without being involved with some kind of equipment or machine, it is surprising that the school has been so little "tainted" with technological fare. In an era when most homes have at least one automobile, washing machine, television set, radio, record player, telephone, and often a slide or motion picture projector, the average schoolroom boasts few of these things. Where a household of four to six persons has the aforementioned equipment (not to mention the materials that go with them), it would seem that a classroom of thirty to forty children should be at least as well equipped. Instead, we find that the average classroom has 1/14 of a radio, 1/4 of a record player, 1/22 of a television receiver, 1/10 of a motion picture projector, and 1/7 of a slide projector.[1]

In other words, on a per-person basis, the school has about 5 per cent of the amount of technological equipment found in the home.

Schools have been little influenced by technology if the volume of equipment is a reliable indicator.[2] Also, there has been little change in the design of schools and methods of teaching over the past fifty years, so it is not surprising that the school system is under fire from groups who consider its methods "archaic" and "inefficient." Considerable pressure is being placed on the educational system to increase its productivity. If technology _is_ a means of achieving this goal, then it demands attention. However, technology is not simply adding something to education.

Study and practice are required to develop skill in the application and use of technology. An understanding of teachers, methods, materials, equipment, and their inter-relationships is essential. Above all, technology requires more clearly defined goals for education to follow.

Whatever methods are adopted to improve learning, the human values must be considered over and above financial and administrative expedience. If the newer materials and methods can reduce "busy work" for the teacher, then there will be more time for creative teaching, where students can develop ideas of their own and interact.

The enemies of technology have constantly emphasized its "dehumanizing" aspects, claiming that machines would replace the teacher, and the child would be bereft of human assistance. It may well be that technology will have exactly the opposite effect. If large-group instruction and the use of television and teaching machines will release more teachers to work with small groups, the possibility exists for more personalized instruction than ever before.

CHAPTER II

SOME CONSIDERATIONS CONCERNING INSTRUCTIONAL TECHNOLOGY

Chapter I presented in capsulated form the problems besetting the educational system as a whole, and the rationale for considering technology as a key to their solution. Instructional Technology, as we have already seen, involves teachers, methods, materials, and as often as not, equipment. Since teaching in the past has involved mostly teachers and teaching methods and very little by way of materials and equipment, a whole new concept of planning, administration, and financing is required. The introduction of technology to instruction can be successful only through proper planning and implementation. It is not a simple change as we will shortly see.

A. The Impact of Technology

Consider what would happen if we were to introduce automobiles in an under-developed country, such as Tibet. To supply the equipment would be futile if nobody knew how to drive, and no one accompanied the autos to teach driving to the Tibetans.

Also, there would be a need for roads on which to drive and service stations for refueling and maintenance. The problem of introducing technology to instruction is not as simple as sending automobiles to Tibet, nor is it as simple as purchasing a motion picture projector or a language laboratory. It is true that a teacher can usually work out techniques of using materials and equipment if they are available, but are they used efficiently and in the manner intended?

Most teachers would admit that a short course in the use of, for example, an overhead projector, opens up vistas of new ideas to improve their own presentations. Few teachers have been taught how to integrate motion pictures with their lessons for optimal results. Many give no introduction to the film, nor do they motivate the students to look for specific item's, and often ~~no time is left to~~ there is no follow-up after a film to reinforce what has been learned and clarify points not properly understood. Very few teachers would consider using only that part of the film which was relevant to the lesson. This is not a criticism of teachers, but it does indicate that few teachers are taught to use the materials at their disposal, nor are they taught the proper use of the equipment. The majority of film damage results from use by operators who do not know the correct way to thread the machine. Fortunately some of the newer equipment recognizes this problem so that projectors are self-threading, or use films in a self-threading cartridge.

School equipment is often inadequately maintained. Just as a car needs lubrication at regular intervals maintenance is required to keep instructional equipment in top working condition. Much school equipment is run like company cars -- until it breaks down -- but unlike the company car which is replaced after one or two years, a piece of classroom equipment might be in use for ten or twelve years or more.

And just as a car needs roads to run on, educational materials and equipment need rooms specially equipped for their use. Materials must be stored so that they are accessible, while equipment often requires specially conditioned rooms. For example, most kinds of projectors require room darkening; sound reproducers require acceptable acoustics; and where a lot of electronic equipment is involved, as with closed circuit television or language labs, special wiring and even air conditioning may be required.

Too often in the past a motion picture projector has been purchased for a school without consideration of a teacher training program, the supply of films, room darkening, or a maintenance contract. The same mistakes are being made today with teaching machines, television, and language laboratories.

Obsolescence is almost never allowed for in-school planning. There are two kinds of obsolescence -- superficial and functional. Given the choice of two pieces of equipment with traditional and modern styling, most people will choose the modern version. One manufacturer of solid and traditional school equipment recently went out of business because schools preferred the streamlined version of his competitor. This is an example of superficial obsolescence, and suggests that the facade as well

as the quality of the equipment is important
~~styling, however functional, might not continue to be used~~
for Teacher acceptance.
~~as long as an equivalent pix unit with a more modern facade.~~

Functional obsolescence is even more crucial. There comes a time when equipment is un-economical to maintain, or when a superior piece of equipment outmodes the old. We accept these facts with automobiles, yet often it is an effort to extend the same kind of thinking to instructional materials and equipment. A textbook or filmstrip may be used long after it has been superceeded, and the same is true of equipment. Teachers cannot be expected to stay with stereoscopes and lantern slides, or even manual slide projectors in a day when many home model slide projectors and television receivers have automatic slide or program change by remote control.

The accessibility of materials and equipment is important to utilization. Few schools have well equipped materials rooms, and many need to book films and filmstrips a year in advance. The theoretical ideal of the self contained classroom, let alone the self contained school, is rarely achieved. Studies by Hoban during World War II proved that utilization of equipment and materials was closely related to their availability. Optimum use of equipment and materials in instruction requires that they be always immediately available. The more red tape and delays involved, the less they will be used. Schools owning their own filmstrip libraries ordinarily make fuller use of these materials than schools which rent them from a central library.

Technology requires a whole new concept of planning, financing, and administration. To return to the analogy of the automobile, consider the possibility that Tibetans will one day need freeways to relieve the pressures and jams in the overcrowded streets. The analogous situation in education is the explosion of knowledge where conventional methods of transmitting information to the student are no longer adequate. The solution to the traffic problem is freeways, which cost over a million dollars a mile. To the Tibetan community the cost might seem out of proportion to their present need, but a point is reached where it is imperative to have the freeway at whatever ~~it~~ cost~~s~~. The day is approaching where American education will need more rapid means of transmitting knowledge and culture to the student, and we must prepare for the new technologies which will bring this about. Present indications are that these technologies will include audio and visual media presented by means of films, filmstrips, slides, television, and teaching machines, with or without sound, and by records, tape recorders, and electronic learning laboratories.

B ~~A~~. The Characteristics of Media.

Media are means of disseminating information, and they are sometimes classified as "time binding" and "space binding." Clay tablets, papyrus scrolls, and books, which ~~have~~ allow~~ed~~ knowledge to be permanently recorded, ~~written down~~ ~~and transmitted to scholars of later times~~, and are aaid to be time binding. Notice that media which are time binding use the means of storage (paper) as the means of transmission. Other media such as smoke signals, semaphore, radio, facsimile, and television enable people in different locations to receive the same message simultaneously, and these media are said to be space binding. Their essential function is to disseminate information, and additional media such as paper, film, and magnetic tape must be involved if a permanent record is required.

With some media the transmission of information occurs in one direction only. Such is the case with mass media such as books, films, radio, and television.

One-way communication is effective in teaching when the information is carefully and skillfully organized to anticipate possible learning problems. However these methods work best when complemented with two-way communication where the student can apply the newly learned information in projects and discussions, and interest with the ideas of classmates and teachers. Media lending themselves to two-way communication include the telephone and other methods of person-to-person communication. Two-way communication can also take place between people and machines, so that a limited amount of instruction can now be performed using mechanical devices.

Tutorail methods involving electronic learning laboratories and programed instruction are so new in education that their role and method of implementation are still the source of controversy and experiment. The electronic learning lab seems to fit best in a laboratory situation, but the teaching machine is still being tested in classroom, laboratory, library, and study areas to determine where it is most effective. It should be noted that these tutorial devices utilize the same media used for mass dissemination, including paper, film, television, and magnetic tape, but the content is designed for a more specific audience, and includes the facility of feedback.

C. The Design of Instructional Systems.

The systems approach ~~would~~ involves an analysis of the instructional process, relating the various functions performed to the educational goals. Such a task would be ~~very~~ complex since the classroom teacher wears many hats, including truant officer, nurse, counsellor, clerk, and janitor. If the major functions of a teacher are to transmit knowledge ~~or~~ and to manage the learning process, ~~then~~ these functions are clouded by the host of additional jobs a teacher is called on to perform. The use of teacher aides has been suggested to take over at least some of these non-teaching functions.

get list from Fortune article

The idea of an instructional system implies an on-going process where there is a planned, organized interaction ~~between~~ of students with information, and culture. This interaction is guided by teachers, and assisted by the best methods, materials, and equipment available. Notice that this definition ~~does~~ is not restricted to disseminating knowledge with the hope that a student will absorb it, but emphasises planned interaction. Also, the teacher is not proposed as the prime means of transmitting information and culture, although in most cases this will be so, but is most important as a guide or manager of the learning process. This is a relatively new concept which has yet to gain the acceptance of the teaching profession.

Can't understand the meaning of the sentence with all the commas [illegible]

[illegible]

If we accept the idea that the role of the teacher is changing, the concept of technology falls into place. If a book, ~~or~~ record, or filmstrip can equal the teacher in some tasks, ~~then~~ they should be used to ~~set~~ free the teacher ~~free~~ for the individual and creative kinds of teaching which no ~~machine~~ book or prepared materials can do. ~~would ever hope to do.~~ even Certainly, many of the routine tasks of transmitting information could be seconded to technological methods of instruction so that the teacher could concentrate on the more creative aspects of learning. It is yet too early to predict the roles of self-teaching devices in relation to human teaching, but such guidelines as "routine" and "creative" would seem useful ones.

Since the purpose of this report is to survey the new instrumentation available to the teacher, to discuss its role and function, and to assess present trends in terms of instructional needs, the remainder of this manuscript will be largely devoted to the equipment aspects of the new educational technologies. It is hoped at some later time to publish companion volumes dealing with the newer materials and methods, but these are still in process since their scope and function are less easily defined and measured, and require further study and research.

D. Equipment Functions

Instrumentation implies the adoption of some mechanism, and instructional instrumentation involves the use of

(Display)

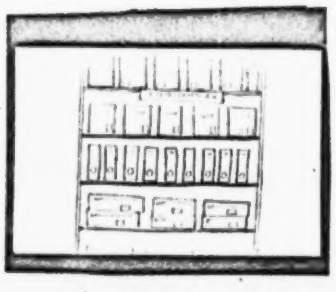
mechanical, optical, and electronic devices in teaching. Chalkboards, maps, charts, globes, etc., are excluded by this definition. Instrumentation for instruction is usually discussed in terms of the medium by which the information is transmitted, such as film, television, and tape recordings. These media perform certain functions such as display, storage, and transmission, or else facilitate functions such as duplicati~~ng~~on and information processing. Present use of the various media is usually dictated by availability of the equipment and materials, but ideally they would be chosen according to learning needs and the functions they perform. This section will discuss these functions in general terms, while more specific information will be found in later chapters.

1. Display. The presentation of visual, sound, or audio-visual stimuli before an audience is called display. Typical media include slides, filmstrips, motion pictures, television, radio, records, and tape recordings. In the classroom, display equipment is normally designed for group use, but there is a growing trend toward individual instruction

SOME MODERN DISPLAY SYSTEMS FOR GROUP USE: 1900-1955

	FILM PROJECTION	ELECTRONIC IMAGES	SOUND
BEFORE 1900	lantern slides~~projector~~ 35mm motion pictures		Edison phonograph Gramophone crystal radio
1900-1925	filmstrips projector opaque projector 16mm motion pictures	~~cathode ray oscilloscope~~	electrical amplifiers radio electrical phonograph
1925-1950	35mm sound motion pictures 16mm sound motion pictures overhead projector(s)	television receivers television projectors	wire recorder microgroove recordings tape recorder
1950-1955	sound filmstrips	videotape recorder	

Table
~~Fig.~~ 1 Group display systems normally involve sounds and images ~~xxx~~ singly or in combination.



(storage)

using scaled down versions of the group display units. Chapters 3, 4, and 5 discuss projection equipment, sound equipment, and television respectively. Other forms of display are mentioned in the chapters on teaching machines, computers, and simulation. ~~Figure~~ Table 1 depicts the ~~relative~~ development of visual display media. ~~up to the year 1955~~.

Check Chapter titles

~~Fig~~Table 1

---

2. Storage of Information. When information is written down or otherwise recorded, it can be stored for later use. Paper is the most generally useful storage medium, but for pictorial information, or compact storage of printed documents, film has many advantages. Magnetic tape is used for recording electrical impulses including sound waves, television signals, and digital information from a computer. Punch cards and punch tape are ~~akxx~~ means of storing information to facilitate subsequent processing in a data processing system or computer, ~~and~~ this is described in Chapter , on Computers. The development of

INFORMATION STORAGE MEDIA, I: LANGUAGE SYMBOLS

	HANDWRITTEN	PRINTED OR DUPLICATED	MICROFILMING	DIGITAL STORAGE	COMBINATION OF PHOTOGRAPHIC & DIGITAL STORAGE
PAPER	notes letters notebooks manuscripts (using pen, pencil, typewriter, etc.)	books monographs journals magazines newspapers data sheets brochures (using spirit duplicator, mimeograph, multigraph, offset, lithography, gravure, etc.	microcard	punch card punch tape magnetic card	aperture card
FILM			Microfilm (processes include conbentional photographic microfilm , kalvar, PCMI[1], photoplastic, and thermoplastic recording)	magnetic tape	minicard microfilm (includes all processes listed under microfilming)
ELECTRONIC				memory modules image storage tube	image storage tube

---

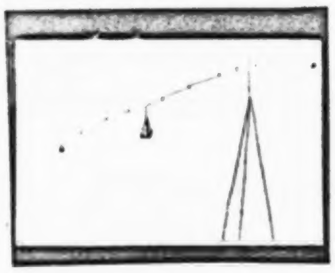
[1] PCMI stand for Photo Chroic Micro Image.

~~Fig.~~ Table 2 . A range of media are available for recording written, printed, and coded data. Note that the media further to the right facilitate rapid storage and retrieval, and miniaturization of the materials involved.

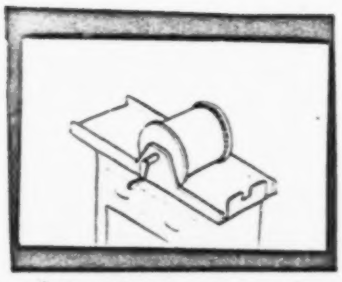
INFORMATION STORAGE MEDIA, II: SOUNDS AND IMAGES

	SOUNDS	STILL PICTURES	STILL PICTURES WITH SOUND	MOTION PICTURES WITH OR WITHOUT SOUND
PAPER	phonograph records magnetic cards	drawings blueprints graphics photographs (materials developed by mechanical drawing, commercial art, art, and photography)	magnetic cards	
FILM	magnetic tape magnetic film optical sound on motinn picture film	slides filmstrips (using conventional black & white and color films, Polaroid film, Vectograph film, Kalvar, photoplastic, etc.) etc.)	sound slides sound filmstrips (see p. for details of individual processes)	motion picture film kinescope videotape (note also the possible use of thermoplastic, photoplastic, PCMI, etc.)
OTHER	conventional phonograph records	image storage tube		

~~Fig.~~ Table 3 . Sounds and images entail special recording problems, so that photographic film and magnetic tape are the dominant media.



(transmission)



(duplication)

storage media is summarized in Tables 2 and 3.

Tables 2 and 3

3. Transmission. Paper is the traditional means of transporting messages, but electronic media are becoming increasingly important because of their speed and convenience. Electronic transmission media include the telephone, telegraph, teletype, facsimile, radio, and television. Film has never been a general purpose transmission medium, being used for specialized information such as motion pictures, filmstrips, or microfilms. Table 4 summarizes the development of transmission media.

Table 4

4. Duplication. With broadcast messages a large number of receivers can be "tuned in" simultaneously, but in most media it is necessary to make multiple copies of the message

METHODS OF INFORMATION TRANSMISSION

TRANSMISSION MEDIUM	SOUND INFORMATION	CODED OR PRINTED INFORMATION	STILL PICTURES	IMAGES IN MOTION WITH OR WITHOUT SOUND
PAPER, FILM, PHONOGRAPH RECORDS, AND OTHER STORAGE MEDIA	postal service, air, rail, truck and all other carriers	postal service, etc.	postal service, etc.	postal service, etc.
SOUND FREQUENCIES	inter-com public address systems		sonar	radar
ELECTRICAL IMPULSES AND TRANSMITTED ALONG WIRES	~~sonar~~ ~~radar~~ inter-com telephone	telegraph teletype data-phone facsimile classroom communicators	photo telegraphy facsimile slow scan television	closed circuit television conference television phonovision
BROADCAST RADIO FREQUENCIES	AM radio FM radio short wave radio two-way radio	radio telegraphy short wave radio	radio-photo	bbroadcast tele television stratovision satellite communication
LIGHT FREQUENCIES	laser beam	laser	laser	laser

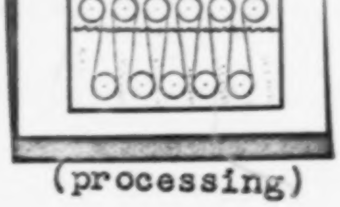
Fig. 2a.11/. Information may be transmitted by distributing physical copies d the message, or by using sound, electrical, or broadcasting media.

DUPLICATING AND COPY METHODS

	MECHANICAL	PHOTOGRAPHIC	ELECTRONIC	OTHER
PAPER	hectograph spirit duplicator mimeograph multigraph offset letterpress rotogravure (including specialized processes such as Addressograph labels)	photo-copying of line and half tone materials. e.g. Photostat Verifax, Royfax, etc. Ozalid, etc. conventional photography of continuous tone and line copy rapid photography using Polaroid film	Xerox and related processes for reproducing line copy transfer and copying of digital data on paper tape and IBM dards	thermal copy methods such as Thermofax Ultra-violet infra-red processes such as Kalvar
FILM	Technicolor's imbibition process for printing motion picture film	conventional photographic printing of slides, filmstrips, transparencies, and motion picture film preparation of slides and transparencies using the photo-copy methods listed above	duplication of magnetic tapes including sound and video tapes	Kalvar, etc. on transparent film base
OTHER	pressing of phonograph records	printed circuits		

Table 5

~~Fig.~~ Commonly used duplicating and copy methods for language symbols, sounds, and images



(processing)

for dissemination. Methods range from carbon paper, office copy machines, and spirit duplicators for a limited number of paper copies to mimeograph, multigraph, offset, photogravure, and letterpress for mass printing. Sound recordings may be duplicated by means of a tape recorder, or mass produced as disc recordings. Pictures can be duplicated by photographic means, by lithography, or electronically using video tape. These will be briefly discussed in Chapter 6, while Table 5 below tabulates their relative development.

Table 5

---

5. Information Processing. Sometimes information must be changed or processed in some way to make it meaningful. For example, test papers are processed to obtain a numerical score, time cards processed to obtain salaries, while the processing of a library request results in the search and retrieval of a book. Test scoring machines are discussed in Chapter 7, while other instances of

FUNCTIONS PERFORMED BY INFORMATION PROCESSING MACHINES

	DATA PROCESSING SYSTEMS	INFORMATION STORAGE AND RETRIEVAL SYSTEMS	INFORMATION REDUCTION AND/OR RECONSTRUCTION SYSTEMS
WITHOUT A COMPUTER	test scoring automated instruction calculator card sorting	searching and selection coding and storage ~~transmission and printout~~	card readers (for IBM cards) card coding + punching printout from digital storage
WITH A COMPUTER	automation of the above addition of memory functions ~~to~~ enable more complex tasks such as scheduling, payroll, school report cards, bâlance sheet, inventory, etc.	automation of the storage and retrieval functions. computerized libraries	optical character readers translating machines phonetic typewriter simulators

Table 6

~~Fig.~~ Information processing usually involves written language or coded data, and includes such functions as selection, coding, storage, symbolic or mathematical manipulation, and printout. The computer ordinarily speeds uo the processing and automates many of the manual functions and decision making processes.

information processing will be found in the subsequent chapters on teaching machines, computers, and simulators. With the growing emphasis on measurement and evaluation, the role of educational data processing is growing in importance. Information processing activities to 1955 are summarized in ~~Table~~ ~~Figure~~ Table 6.

~~Fig.~~ Table 6

E. Trends in Modern Equipment.

Reliability and performance are not the only features which make~~s~~ modern instructional equipment superior to the devices of ten years ago. Factors such as human engineering, flexible usage, reduction in size and weight, + the development of special purpose units such as those ~~developed~~ for individual learning, ~~and the development~~ of two-way methods of ~~instruction for~~ both large group and ~~individual learning~~ situation, represent ~~real~~ important advances in instructional technology.

1. Reliability and Performance. Manufacturers are now building equipment which is rugged enough to withstand ordinary classroom handling and hazards. Reliability is an especial concern, since schools do not normally have technicians to keep the equipment working. Some large and expensive units, such as language labs or closed circuit television, use modular construction to allow unskilled personnel to quickly replace faulty units. Thus a television receiver, tape deck, amplifier panel, or set of earphones, can be easily replaced.

Performance standards, such as sound distortion and frequency response, image brightness, screen size, and noise level of equipment, are receiving extensive consideration from designers and engineers. However, until educators specify what their needs are in this regard, there will continue to be a large differential in performance of the products of many manufacturers.

Fig 1. aa?

2. Engineering Standards. The fact that films, filmstrips, and phonograph records are interchangeable from one machine to another is no accident. Engineering standards are set up for size, playing speed, etc., at an early stage of development so that users will not have the expense and inconvenience of separate pieces of equipment for the materials of different manufacturers. Problems do arise when a new innovation leads to the development of a new standard, which is not compatible with the old. For example, microgroove recordings have a playing speed and stylus curvature different from the standard 78 rpm records. The problem now exists with ¼-inch magnetic tape as to whether to record one, two, or four soundtracks side by side. The introduction of 8mm sound films and projectors may also introduce a new standard for school motion picture equipment. As with performance standards, educators need to specify their requirements in some concerted fashion. There has been a long history of education adapting equipment designed for other purposes, rather than having equipment designed to meet its own specific needs.

3. Human Engineering. The requests of teachers for equipment which is lighter to carry and simpler to operate are ~~now~~ being implemented through human engineering. A series of controls may be reduced to a single switch, or organized in a more functional layout. Film projectors and tape recorders may be self-threading, or use cartridge loading. Built in screens, remote control units, random access devices, and multiple purpose units are making equipment more functional than ever before.

Human engineering of another kind is being applied to the utilization aspects, including ~~Elements such as~~ screen size, viewing angle, height related to eye level, distance of the viewer from the screen, brightness, ambient illumination, and sound quality. Where equipment is to be permanently installed, many ~~most~~ manufacturers now pay attention to these details.

4. Flexibility. No teacher wants a dozen pieces of equipment to do what a single unit can do, and this perhaps ~~is~~ explains the success of projection closets emplaying

rear projection, where both slide and motion picture projectors are included along with record player and public address unit in a single cabinet. The same trend is evident in television equipment, where a portable podium carries a permanently mounted television camera to enlarge pages from books and microscope sections, overhead transparencies, slides, filmstrips, and motion pictures projected from the rear. Again a public address system is built in as part of the unit.

5. Miniaturization. Improvement in materials and design, assisted by innovations such as transistor amplifiers, makes equipment smaller and lighter than formerly. The higher information carrying capacity of modern films and tapes is also making it possible to reduce the bulk of materials and the size of equipment needed for presentation. Although the reduction in cost is not proportional to the reduction in size (since greater precision is usually needed), the ultimate savings in the costs of materials may be considerable.

6. Special Purpose Units. The growing market now makes it economically feasible to manufacture units for special applications, so that a whole range of specialized ~~purpose~~ equipment has come into being, ~~These~~ include, controlled reading devices, audiometers, vision testers, and ~~a whole range of~~ equipment for individual (as compared to group) instruction.

7. Individual Learning. The growing use of listening and viewing devices for individual instruction is a stimulus to the growth of new kinds of equipment such as junction boxes to listen to record players through earphones and desk top viewers with rear projection screens. The need for more two-way communication of a tutorial nature has led to the development of language laboratories, and teaching machines, and a host of related equipment to facilitate rapid learning.

8. Group Systems. Superior methods of display are being developed for large-group teaching, some of which involve the use of more than one viewing screen. There is a parallel development toward maximizing feedback from the

class, using group response systems of various kinds. Push-button response units allow a regular evaluation of class performance, while in closed circuit television installations, talkback devices enable students in the classroom to present questions to the master teacher in the studio.

F. The Impact of Technology on the Classroom.

The pattern of school organization is changing, as new ideas become realities. Academic lecture methods are giving way to more visual approaches to learning. There ~~are~~ is an increasing number of laboratory and workshop situations where students can practice verbal and non-verbal skills. Simulators are being introduced to train psycho-motor or co-ordinate skills. Routine learning tasks are being relegated more and more to individual study using books, phonograph records, flash cards, tape recorders, electronic learning laboratories, and teaching machines, depending on the particular skills involved. There is even speculation as to the possible use of the computer in some of these areas.

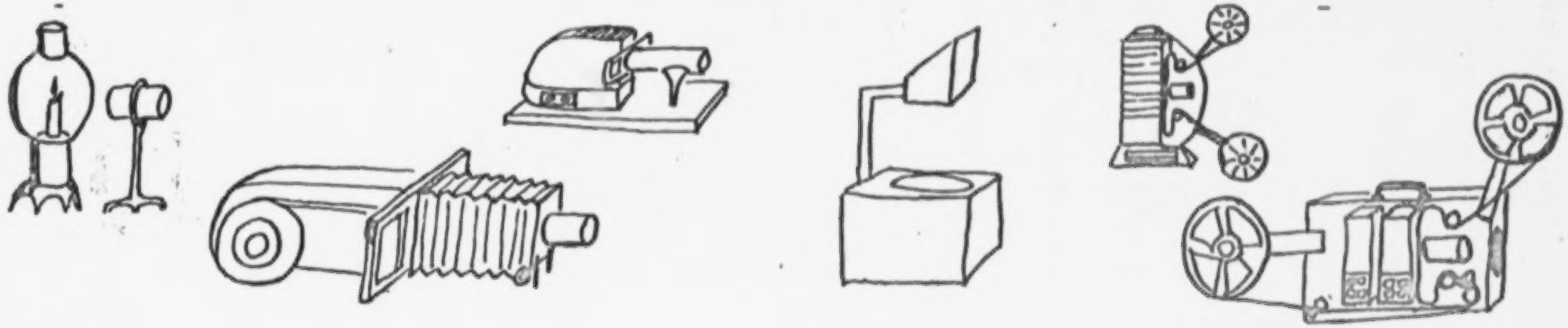
It is certain that the role of the teacher is changing to fit these new patterns.[1] Terms like team-teaching, master teacher, and are indicative of the new roles teachers are being called upon to perform. Of necessity, the role of the teacher is becoming more specialized as the instructional system is continually refined and rebuilt to meet modern needs. These changes are not the result of manipulation by mysterious outside forces. They can result only when teachers and administrators gain the support of the community at large to plan and implement such changes.

---

[1] Up-to-date information on equipment can always be obtained from the National Education Association, the National Audio-Visual (Dealers) Association, and the Electronic Industries Association (Manufacturers). Many teachers' magazines publish the gist of recent research.

Add Section
on SYSTEMS
here or in
end Chapter.

PROJECTION



III
OPTICAL PROJECTION EQUIPMENT

A. INTRODUCTION

Projection equipment was one of the first technological developments introduced into the classroom. The chalkboard, models, textbooks, paper and pencil, and other products of technology were already in evidence in the school of the 1890's. Motion pictures, radio, the automobile, and the aeroplane were shortly to revolutionize the American way of life, but American education was not to feel the impact of technology until 20 or 30 years later. Photography had already existed for more than 50 years, and the magic lantern for nearly 300 years. Their combined application to learning was only a matter of time.

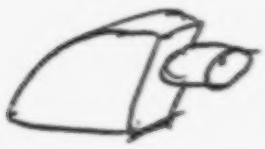
1. Purpose

Projection equipment is designed to give a magnified display of information, both pictorial and printed, in black and white or in color. In the classroom it is used to display opaque objects and materials, transparencies, slides, filmstrips, and motion pictures. Photographic film makes available a large variety of materials at relatively low cost, requires a minimum of storage space, and is simple to use. All projectors excepting the overhead transparency projector require some degree of room darkening except where small rear projection screens are used. Under proper conditions of use, projected materials serve to focus attention, clarify meaning, and build understanding through the use of color, movement, synchronized sound, and other techniques known to assist learning.

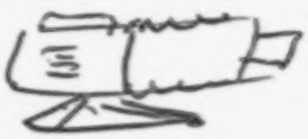
2 History

The *camera obscura* and magic lantern are the forerunners of modern projection equipment. The lantern slide projector was introduced in the 1890's along with the "Keystone 600" set of slides and stereographs designed especially for school use. The 35mm filmstrip projector, introduced about 1915, remained a curiosity to educators for over 20 years through lack of suitable materials. Meanwhile, the ability of the motion picture to teach and to influence attitudes attracted considerable attention, so that the introduction of 16mm film in 1923, the addition of sound in 1930, and research funds made available by foundations at this time led to its rapid adoption as an educational tool.

World War II held up development of the film program in the schools, but meanwhile the military improved the equipment and techniques for their own instructional film program. The overhead projector also evolved during this period. After the war, the schools continued to build their motion programs, supplemented in the early 1950's by a growing availability and use of filmstrips. Until 1955, the principal items of projection equipment used by the schools included:



OPAQUE
PROJECTOR



LANTERN
SLIDE
PROJ.

a. opaque projector

b. lantern slide projector

c. slide-filmstrip projector

d. overhead projector

e. motion picture projector

Each of these will be briefly described before proceeding to a discussion of newer developments.

____

sketch

____

a. Opaque projector. An enlarged display of hand-written and printed materials before a group of students can be accomplished using an opaque projector. The low light output of this device requires that the room be thoroughly darkened for successful operation.

____

sketch

____

b. Lantern-slide projector. 3½X4 glass-bound lantern slides are still used by numerous science departments,

Ch.____ Page 5
OPTICAL
PROJECTION
EQUIP.

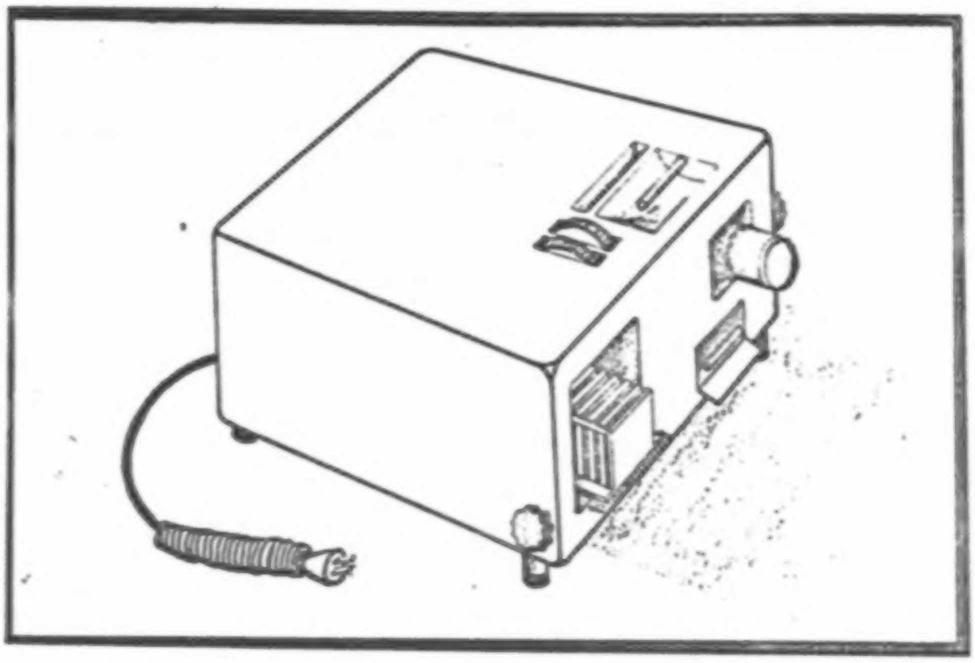


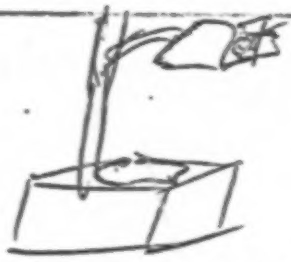
Fig. No Number (Slide - Filmstrip Projector)

Neg. No 2002

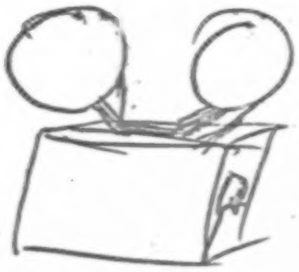
but because they are heavy and fragile, 35mm filmstrips and 35mm slides in 2X2 mounts are rapidly replacing them. Only a limited selection of lantern slides is available for educational use, in contrast to 35mm filmstrips which are relatively inexpensive and freely available.

SLIDE-
FILMSTRIP
PROJ

C. Slide-filmstrip projector. This device is outstanding for its simplicity and the available range of excellent materials. Filmstrips efficiently present single concepts or whole units of instruction, while slides allow the teacher greater flexibility in organizing a presentation. Each provides a very compact storage of large volumes of pictorial material. The majority of filmstrips are now made in color, and because of their low price many schools are building their own filmstrip libraries. A variation of the slide-filmstrip projector is the micro-projector which projects a tiny area from a microscope slide instead of using photographically prepared materials.



OVERHEAD
PROJECTOR



MOTION PIC.
PROJECTOR

__________ __________ d. *Overhead projector*. During World War II, the military found need for a projector which operated from the front of the classroom in full room light, and allowed the instructor to write directly on the screen like a chalkboard. The outcome was the overhead projector, a particularly useful tool which is only now being introduced into schools. There are probably many schools which do not yet know if its existence.

__________ __________ e. *Motion-picture projector*. The most versatile of all classroom projectors is the 16mm sound motion picture projector, which explains its early popularity as an educational tool. Through the use of movement and sound, films serve to clarify meanings involving motion, heighten reality, bring the world into the classroom, and promote understanding of abstract relationships. They provide vivid learning experiences including historical re-enactments and current events, time-lapse and slow motion photography, events under the microscope (processes invisible to the naked eye), and all manner of vicarious experiences. The cost of film prints to this point in time has encouraged centralized storage in university libraries and large urban centers. Methods are now being sought to make sound motion picture materials more immediately available.

Table I in the Appendix lists the suppliers of the various kinds of equipment.[1]

---

[1] More complete information on the conventional types of projection devices appears in The Audio-Visual Equipment Directory: A Guide to Current Models of Audio-Visual Equipment published annually by the National Audio-Visual Association, Inc., of Fairfax, Virginia.

B. TRENDS AND DEVELOPMENTS SINCE 1955

Recent changes in projection equipment include an overall increase in light output, simpler operation, the introduction of rear projection units, development of special purpose projectors including those for individual instruction, and the addition of sound to still projectors. These trends will be described in terms of specific items of equipment which appear in the directory at the end of this chapter unless indicated otherwise.

1. Increased Light Output.

Two developments have contributed to the increase in brilliance of modern projectors: new kinds of projection lamps, and the design of more efficient optical systems.

a. *New Light Sources.* The use of internal reflectors, low voltage lamps, more compact filament designs, envelopes of fused quartz around the filament to prevent evaporation, and new filament materials of higher melting point all contributed to the increase in light output. Low power lamps now give brilliance comparable to many of their older, higher-power counterparts, and the heat factor has been so reduced in some instances that forced air cooling can be dispensed with. Figure 1 shows some of these newer lamps alongside a conventional 750W projection bulb.

A number of new high-power sources have been introduced for auditorium projectors. The Bauer 16mm sound projector can be obtained with a Xenon arc, while Aeronutronics uses a Zirconium arc for their multiple head slide projector.

b. Improved Optics. New technologies of lens design utilizing computers have revolutionized the optical industry. Where once mathematicians would have spent years computing a new lens design, modern digital computers can rapidly formulate a whole lens system to meet a given specification. The result is a reduction in cost, along with an increase in quality and efficiency of the optical components. Also, new items, such as anamorphic lenses and zoom lenses, can

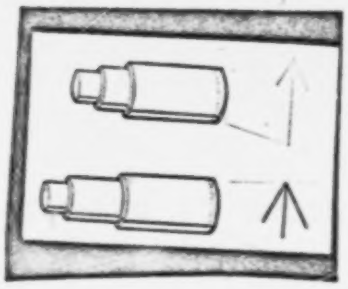


Fig. 2 A zoom lens covers a wider or narrower field of v view by moving the front element back and forth.

be marketed at prices comparable to the more conventional lens systems.

2. Ease of Operation.

Several advances now make projection equipment more functional and easier to operate. Zoom lenses allow the size of the projected image to be varied without moving the projector. Automatic threading or film cartridges simplify the loading and rewinding of the film. Automatic advance and remote control on slide and filmstrip projectors allow the teacher to operate the equipment from the front of the room.

a. Zoom Lenses. In the past it was necessary to have a range of projection lenses and to move the projector back and forth relative to the screen to get a picture of the required size. This can now be accomplished optically using a lens of variable focal length, popularly called a "zoom" lens. The projector is situated a convenient distance from the screen and the image varied in size by moving the front lens assembly back and forth. See Figure 2. Zoom lenses are available for many of the newer slide and motion picture projectors.

b. Automatic Threading. The need to simplify the threading of a motion picture projector has been recognized by several manufacturers, and a number of self-threading machines are already on the market. In the 16mm field, Bell & Howell have pioneered this approach, while several 8mm units for home use have this feature.

c. Film Cartridge. An alternate method is to seal the film in a cartridge where hands never touch it, so that the operator has only to plug in the cartridge and turn on the machine. The design of cartridges for sound motion pictures has presented a problem because of the need for intermittent movement for picture and continuous motion for sound, but such problems have now been overcome.

Altogether there are four varieties of film cartridge, including reel-to-reel cartridges, flip-over cartridges,

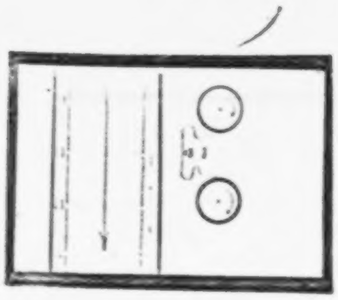


Fig.3 Reel to reel cartridge. The two reels are permanently enclosed within a box to eliminate the need for threading

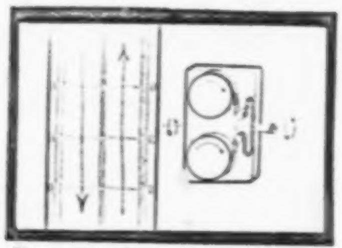


Fig. 4 Flip-over cartridge. This is essentially the same as the reel-to-reel version but only half of the width of the film is uded so that turning the cartridge over at the half-way mark rewinds it ready for the next usage.

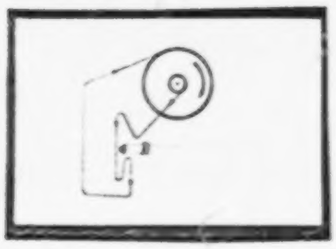


Fig. 5 Continuous loop attachment. The loop former replaces the top projection re reel, but the unit must be hand threaded in the normal manner. The loop eliminates the need for rewinding so long as the whole presentation is used. It is not possible to back up to repeat sections.

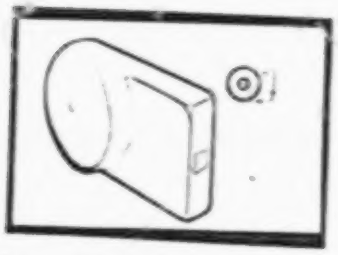


Fig. 6 Continuous loop cartridge. The cartridge eliminates the need for threading, but is otherwise similar to the loop attachment. All cartridges are designed as an integral part of the projection equipment.

continuous loop attachments, and continuous loop cartridges. (A continuous loop attachment is not strictly a cartridge, but is included here for the sake of expediency.)

(1). Reel-to-reel cartridges enclose feed and take-up reels in a single casing, eliminate the need for threading, and facilitate automatic stop and rewind at the end of the film. No motion picture device uses this type of cartridge at the present time, but Execugraf (Figure 3) has adopted it for 35mm filmstrips.

(2). Flip-over cartridges eliminate the need for rewinding since there is a set of images along each edge of the film, and turning it over at the half-way mark makes it self rewinding. This system is used by Mast (Figure 4) for 35mm filmstrips, and by A-16 Enterprises for their double 8mm motion picture projector.

(3). Continuous loop attachments have existed for many years, and their use has been restricted to devices for sales display where repetitive or continuous operation

FILM CARTRIDGES AND LOOP FORMERS[1]

In music bag

	CARTRIDGE TYPE				FILM TYPE AND SIZE							used in teaching machine
	Reel-to-Reel	Flip-over	Continuous loop attachment	Continuous loop Cartridge	Still Picture	Motion Picture	8mm	16mm	35mm	silent	sound	
A-16 Enterprises *		X				X	X	X			X	
Cousino			X			X	X	X			X	
Execugraf	X				X				X	X	X[2]	
Fairchild				X		X	X				X	
Mast		X			X				X	X		X
MPO Videotronics			X			X	X				X	
Technicolor				X		X	X			X		
TV Associates			X			X	X	X			X	
Vicom			X			X	X				X	
Visutronics				X		X	X				X[3]	

Table 7

---

[1] This list does not include 16mm continuous loop projectors since these are amply documented in ~~XXXXXXXXXXXXXXXXXX~~ _The Audio Visual Equipment Directory_ published annually by the National Audio-Visual Association.

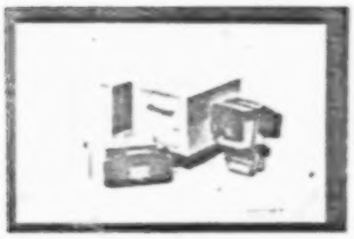
[2] Uses separate tape cartridge

[3] Integral tape and film cartridge

* Not currently in production.

FILM CARTRIDGES (1)
and
attachments

(7.) Cousino

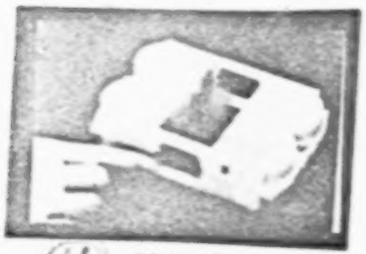


(8). Execugraf

DON TO
ENLARGE or find
FROM FIG. —
(attachment)

~~9. Fairchild~~ LOOP FORMER

10. Fairchild (cartridge)



(11) Mast

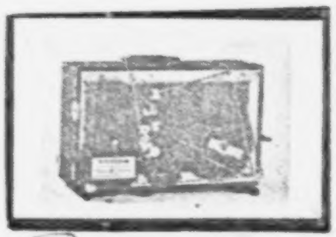
Find in picture
file

(12.) MPO Videotronics

FILM CARTRIDGES (2)
and attachments

⑬ Technicolor

⑭. TV Associates



P

⑮. Vicom.

⑯. Visutronics

is required. Here the feed and take-up reels are replaced by a loop-forming mechanism, but the threading and operation of the projector is otherwise the same. See Figure 5. A number of 8mm sound projectors have been specially designed for this type of unit, including the older Fairchild (Figure 9), MPO Videotronics (Figure 12), and Vicom (Figure 15). Loop-forming attachments for use with any 8mm projector are manufactured by Cousino (Figure 7) and Television Associates (Figure 14).

(4). Continuous loop cartridges are the easiest method of handling film, from the user's point of view. These are completely self-threading, so that to operate the projector, it is merely necessary to slide the cartridge into position and turn on the machine. See Figure 6. Technicolor (Figure 13) adopted this approach for their silent 8mm projector, while Fairchild (Figure 10) perfected a similar cartridge for 8mm sound film. So long as the film is run through to the end, it is ready for the next screen-

DON TO
SHOOT
TO
COME

Fig. 17 Remote Control.
This hand control unit will permit focusing back and forth in addition to advancing and reversing slides. (Kodak Carousel)

AVACORD 105

Fig. 8 Special remote control cords are available on special order for many kinds of ~~equipmen~~ equipment. (Avac~~ord~~) AVACO

ing. Rewinding is unnecessary, and print life is greatly extended. Visutronics (Figure 16) has a dual cartridge for 8mm film and $\frac{1}{4}$" magnetic sound tape. See Table 7.

d. Automatic Advance. Automatic mechanisms to advance filmstrips and change slides have paved the way for a host of new applications involving remote control, random access, and other forms of automation. Most home slide projectors now have automatic advance triggered by a built-in interval timer or remote pushbutton as required.

e. Remote Control. Remote operation allows the teacher to have complete control of the projector from the front of the room, which is advantageous for focusing attention, pointing out items of special interest, integrating projected media with chalkboard and other forms of display, and maintaining discipline. Remote control is available on the Graflex and Viewlex filmstrip projectors, and on most brands of 2X2 slide projectors. The best of these include forward and reverse along with focus, while in a

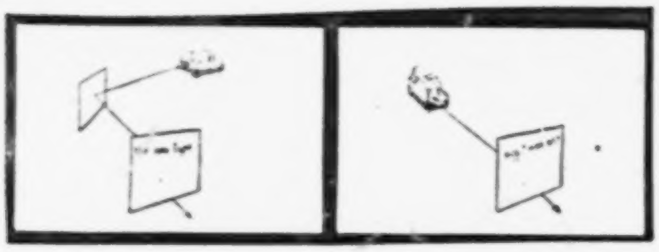


Fig. 19+20 Rear Projection.
A mirror is needed to reverse the image from right to left on a rear projection screen.

RUN

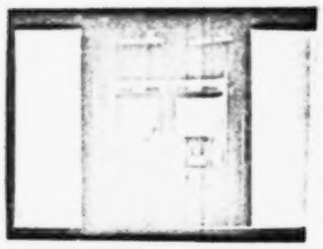


Fig. 21 An interesting application of rear projection in conjunction with the overhead projector was devised for a television show. The light sources are high above the participants desk. Mirrors beneath the stage redirect the image to the back of the screen. (~~Buntek~~ Buhl)

few instances even the on-off switching is remotely controlled. Avacord (Figure 18) manufactures special on-off cords for remote control in addition to cords to trigger automated units.

3. Portable Rear Projection Units.

An alternate to remote controlled equipment operating from the back of the classroom is rear projection equipment at the front of the room. This would normally reverse the image from right to left, so that a mirror is needed to correct the left-to-right relationship as shown in Figures 19 and 20.

Separate rear projection screens are available for use with any existing projector.

Only those units where screen and projector have been built as an integral device will be considered in this section. Those with small screens are intended for daylight projection, while those with larger screens require room darkening. These larger cabinets lend themselves to

REAR PROJECTION UNITS

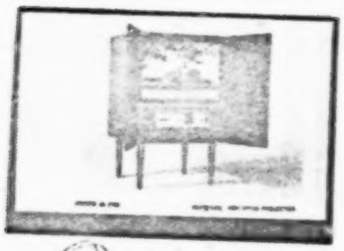
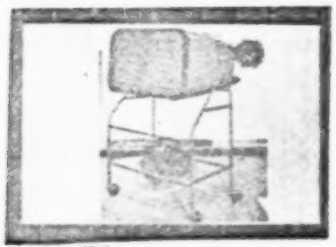
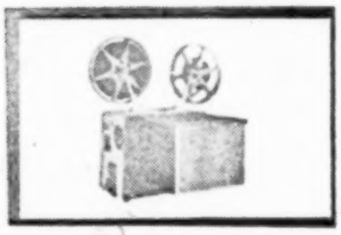


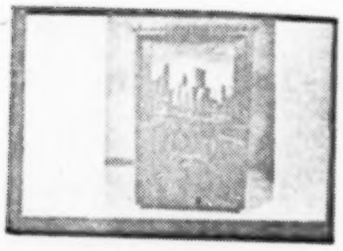
Fig. 22. Argus



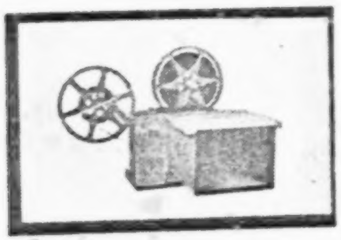
23. Hoover Brothers



24 Kalart-Victor



25 Lester Dyne



26 Movie-Mite

the installation of both slide and filmstrip projectors, or the inclusion of a complete audio-visual facility.

a. Daylight Projection Units. Because many classrooms lack light control, manufacturers have developed rear projection units for use with normal room light. These units require only that the screen surface be shaded from direct window light. Integral rear projection units for slides are available from Argus (Figure 22) and Lester Dyne (Figure 25), and for 16mm sound projectors from Da-Master (Figure 23), Movie-Mite (Figure 26), and Victor (Figure 24). Other varieties are available for sales display purposes.[1] The so-called "desk top" units for slides, filmstrips, and 8mm motion pictures will be reviewed later.

b. Multi-purpose Units. All except the smallest rear projection units are so heavy as to require some kind

---

[1] See National Audio-Visual Association directory.

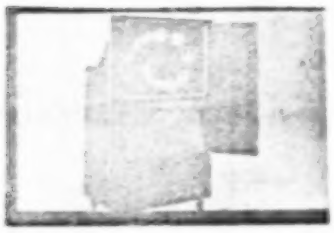
REAR SCREEN XXXXXXXX PROJECTION UNITS

	Single Projector	Multiple Projectors	16mm Snd. Motion Pic	2 X 2 Slides	35mm Filmstrip	Overhead Projector	Record Player	Tape Recorder	Public Address	Remote Control
Argus	X			X						
BiFi		X	X	X	X		X			
Burtek	X					X				
Busch		X	X	X	X		X			
Harwald		X	X	X	X		X			
Hoover	X		X							
Lester Dyne	X			X				X		
Kalart-Victor	X		X							
MovieMite	X		X							
Ralke		X	X	X	X		X		X	
Staples Hoppmann		X	X	X	X	X			X	X
Teleprompter		X	X	X	X			X	X	X

see also Reading Pacers
Individual Viewing Devices
Individual Sound Viewing Devices
Multiple Screen Projection
Large Screen Displays

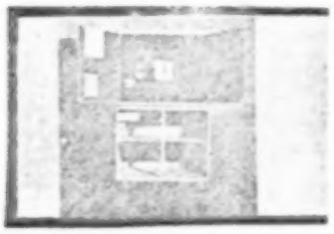
Table 8

MULTIPLE PROJECTION UNITS


27a BiFi (front view)

27b Bi-Fi (rear view)

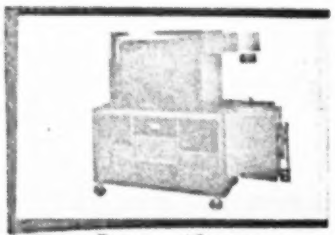
28a Busch (front view)

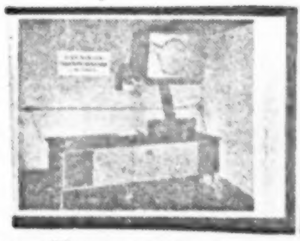

28b Busch (rear view)

29 Harwald

30 ✓ CALL RALKE
OR COPY FROM
BROCHURE.

Ralke


31 Staples Hoppmann


32a Staples Hoppmann
Edling Console
(front view)

32b Staples Hoppmann
Edling Console
(rear view)

of wheel ~~trolly~~ dolly or built-in castors for mobility. The essential equipment would normally include a motion picture projector, speaker, and screen. The added cost of a slide projector, record player (operating through the projector amplifier) or even a tape recorder is small compared to the cost of the total unit. Several companies are building multi-purpose units of this nature. The equipment is always permanently set up in relation to the screen, and requires only the appropriate materials to make it operational. This is the equivalent in equipment of the packages of materials now available which include films, filmstrips, records, student workbooks, samples of materials, and teachers' guides. With such a package, the teacher has the resource materials readily available; with the rear projection cabinet, the necessary complement of equipment is also available. Multi-purpose units are manufactured by Busch (Figure 28), Bi-Fi (Figure 27), Harwald (Figure 29), Ralke (Figure 30), and Staples Hoppman (Figure 31, 32). The two latter units also have a remote control panel with microphone, and can be used in a small auditorium.

4. More Flexible Display Techniques.

The sound motion picture has always been regarded as the ultimate in display equipment. Many advantages once peculiar to the sound motion picture have now been extended to still projectors. These include the possibility of limited motion and the addition of synchronized sound.

a. Polarized Light Effects. The illusion of flow and motion can be achieved using circularly polarized slide materials and a rotating polarizer on the projection lens. The Technamation process for overhead transparencies employs cut-outs of polarized material for areas where motion is required. A multitude of patterns and colors is available so that different moving elements can be readily distinguished. Such presentations are useful for highly intricate flow diagrams, and are much less costly than animated films. The ingenious user can simulate many kinds of repetitive motion with this technique.

Polaroid Vectograph film allows polarized objects to be photographed in terms of polarization angle, so that slides and filmstrips can also achieve these limited motion effects. The circularly polarized materials and rotating polarizer are available from Technifax, while Vectograph film comes from the Polaroid Corporation.

b. Synchronized Sound. The growing popularity of sound filmstrips has led to the development of mechanisms to advance the picture when triggered by a pulse on the recording. In this way, slides or filmstrips may be synchronized with phonograph records or tape recordings, and so long as both are started together they will advance in synchronism. Such units are made by C. O. Baptista, Brereton Grover, Camera Optics, DuKane, McClure, Synchromat, and others. Desk top units for individual use are listed later.

The inconvenience of storing and setting up two physically separate media has led to the development of

GET FROM
PIC
FILE

Fig. (63) A modern sound filmstrip projector which advances the film by an inaudible signal on the record. (DuKane)

INTEGRAL SOUND-SLIDES AND SOUND-FILMSTRIPS

	PICTURE FORMAT		SOUND FORMAT		
	slide	filmstrip	magnetic	optical	mechanical groove
Gray	X				X
Kalart		X		X	
Instructors Inc	X				X
Revere (3-M)	X		X		
Soundial		X*			X

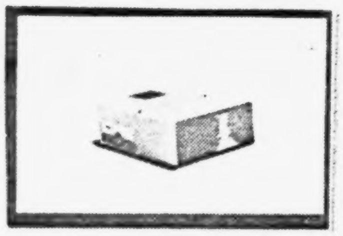
* IN MOUNT INTEGRAL WITH RECORD

Table 9

INTEGRATED SOUND-SLIDES AND SOUND-FILMSTRIPS

In music ?

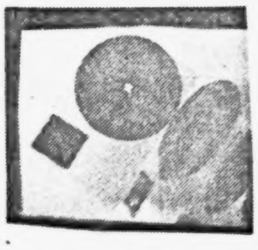
(34) Gray Sound Slide



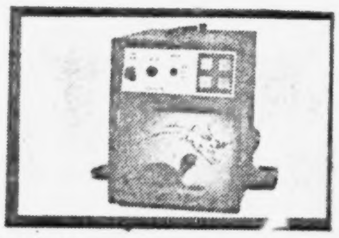
(35) Gray Sound Slide Projector set up for rear projection

(36) Kalart Sound Filmstrip

(37) Kalart Sound Filmstrip Projector



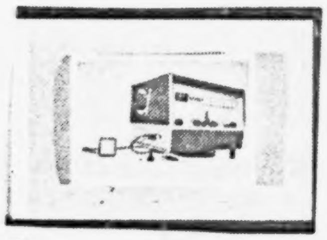
38 Instructors Inc.
Envelope contains
dictation machine
record and piece of
film as in 2X2 slide.



in Ind. S. U.

(39) Instructors Inc Projector

(40) Revere (3-M) Sound Slides



(41) Revere Sound Projector.

(41a) Sundial

integral sound-picture media, which also have the advantage of being automatically in synchronization wherever the series is started. Kalart (Figure 36, 37) solved the problem by printing optical sound on alternate frames of a double frame filmstrip. The projector is self-threading, simple to operate, and advances whenever the end of the sound is reached. Optical sound is advantageous in that it is inexpensive to duplicate.

Gray (Figure 34, 35) uses 35mm slides in $3\frac{1}{2}$X$3\frac{1}{2}$" plastic mounts on which up to 90 seconds of sound is stored in a conventional groove recording. Instructors, Inc. (Figure 38, 39) uses dictating machine records in a series of plastic envelopes which hold the companion slide for each recording. Revere (Figure 40, 41) has special slide mounts with a magnetic coating so that 20 seconds of sound can accompany each slide. Processes using slides facilitate the development of user-prepared materials, and also allow great flexibility in the arrangement of the individual slide modules.

6. Special Purpose Units.

All of the projectors mentioned so far could find applications in ahy classroom for teaching almost any subject. There are some kinds of projector which find use in only one or two areas of the curriculum. Examples would include time and motion study projectors and reading pacers.

a. *Time and motion study projectors* are used mostly for physical education, but they facilitate the projection of still frames. Such projectors are readily adapted for searching through large volumes of material and for "random access". Random access is the ability to go directly and automatically to the information required for display. This facility has become especially important in information storage and retrieval. The same feature is also incorporated into many teaching machines for "branching". The student is sent by this means to additional learning sequences.

Reading pacers are often adaptations of regular projection equipment, and were among the first special-purpose

Nurse

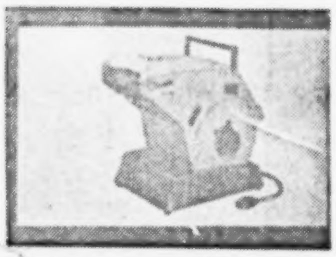


Fig. 47 Diagnostic equipment used by the school nurse ~~ix~~ to test vision. (Titmus Optical)

TIME AND MOTION STUDY PROJECTORS

	16mm	8mm	single frame advance	remote operation
Camera Equipment Co ~~Bell & Howell~~	X		X	X
Kodak	X	X		X
L.W. Photo Inc.	X		X	X
Perceptascope * ~~Development Labs~~	X		X	X
Weinberg Watson	X		X	X

* also automatic stop on cue

Table 10

projectors to gain widespread use. Considerable differences in reading ability and learning speed led to the development of units for individual instruction and this proved to be the forerunner of the trend to individual learning which will soon affect most areas of the curriculum.

a. Time and Motion Study Projectors. The first time and motion study projectors were developed for scientists, but they are also used by sports coaches to slow down, stop, and repeat actions for closer analysis. The newer machines offer flickerless projection down to one frame per second, and single frame projection without loss of brilliance or focus, all by remote control. Such projectors could be invaluable to teachers in the sciences, arts, and humanities, since the film could be stopped for detailed study at any time. For the present, most time and motion study projectors do not have sound except on special order, nor is the sound useable at speeds slower than 24 frames per second. Manufacturers include Bell & Howell (Figure 43a), Kodak (Figure

TIME AND MOTION STUDY PROJECTORS

NO PIC.
NO ANS. TO LETTERS
HAVE BROCHURE

(43-[illegible]) Camera Equipment Co
(modified Bell & Howell)
Camera Equipment Co.

FIND
IN FILE

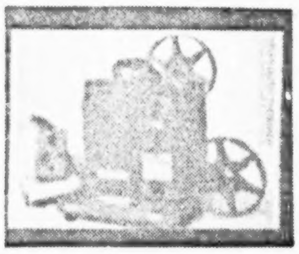
FIND IN
PIC. FILE

(Sent $ 55 in 8mm. [illegible])

Need
a cc.
[illegible] (44) Kodak Analyst - 16mm

(45) Kodak Analyst - 8mm

No
small copy



? (46) LW
(modified Kodak Analyst)

~~[illegible]~~

(47) Perceptoscope

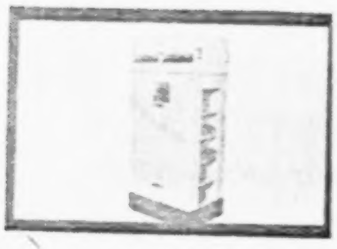
(48) Weinberg Watson
(modified Kodak Analyst)

RANDOM ACCESS PROJECTORS
FOR SLIDES AND FILMSTRIPS

	2X2 slides	lantern slides	filmstrip	capacity
Blonder Tongue	X	X		
Mast			X	
Pictronics			X	
Spindler & Sauppe	X			
Teleprompter	X	X		

Table 11

RANDOM ACCESS PROJECTORS



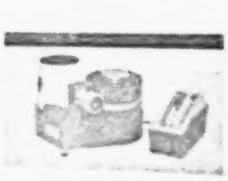
(49) Blonder Tongue

(50) Mast

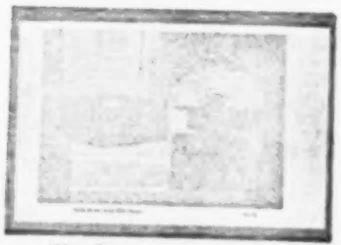
(50a) "

Brochure only.

Pictronics



(51) Spindler & Sauppe



(52) Teleprompter

(52a) Teleprompter Coo

44, 45), LW (Figure 46), Weinberg-Watson (Figure 48), and Perceptoscope (Figure 47). This latter machine can also be used as a reading pacer.

b. Random Access. When an information system becomes very large, whether it stores slides, films, or library books, special forms of organization are needed to make the information easily accessible. In some instances the random access capability is automated. For example, Spindler and Sauppe (Figure 51) and Teleprompter (Figure 52) have slide projectors where any slide can be called up at random by punching in the number of the slide. Mast (Figure 50) and Pictronics have filmstrip projectors with a similar facility.

Random access projectors are an integral part of some of the newer microfilm viewers for use in libraries, including machines by FMA, Information Retrieval, and Recordak. Further details will be found in the chapter on computers.

Random access projectors also find use in teaching machines using "branching" programs, including those by Honeywell, Thompson Ramo Wooldridge, and U. S. Industries. Further information on these machines may be found in the chapter on teaching machines.

Most of the larger random access storages use edge codings on the film to locate the desired frame, and a logical extension of this is a code for cross-indexing with searching controlled by a computer. Random access projectors are an important link between the old time and motion study projectors, and the devices found in computerized storage and retrieval systems.

C. Controlled Reading Devices. The reading pacer and tachistoscope are usually modified projectors, although some of the same functions can be achieved without projector mechanisms. The function of the reading pacer is to scan or unmask written materials line by line at a controlled

TACHISTOSCOPES AND READING PACERS

	Tachistoscope			Reading Pacer				
	uses printed materials	uses film materials	projector attachment	for individual use	for group use	printed materials	film materials	tachistoscopic function
Anirama				X	X		X	
Audio Visual Research				X		X		
Better Reading Program	X							
Book of the ~~Week~~ Month Club ~~(Columbia Reading Program)~~	X							
Craig Research				X			X	X
Educational Development Laboratories	X				X		X	X
Graflex			X					
Keystone			X	X		X		
Lafayette Instruments			X					
Learning through Seeing		X						
Perceptual Development Labs					X		X	X
Psychotechnics				X		X		X
Reading Trainer				X		X		
~~Science Research Associates~~				X		X		

Table 12a

TACHISTOSCOPES

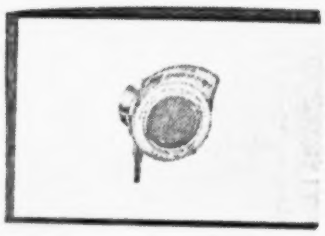
52

DON TO PHOTOGRAPH ✓ / R Pau

Better Reading Program

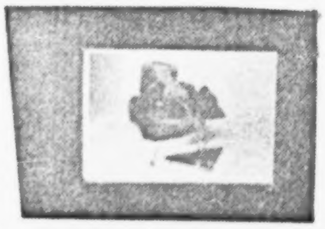
✓

(54) Educational Development Labs



(55) Graflex

(56) Keystone



(57) Lafayetter Instrument Co.

(58) Learning through Seeing Inc.

READING PACERS

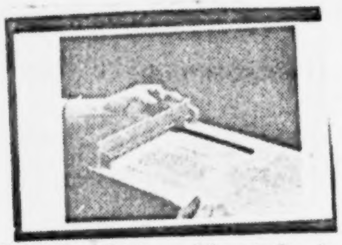
1. FOR GROUP USE

(59) Educational Development Labs.

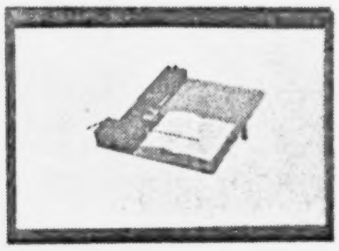
(60) Perceptoscope

READING PACERS

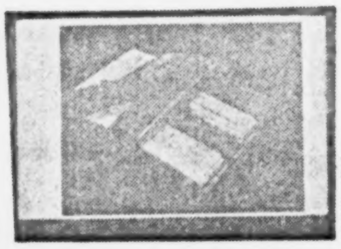
2. Mechanical Scanners for individual use



61 Book of the Month Club



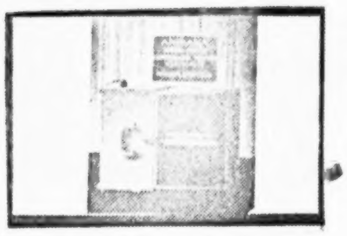
62 Keystone



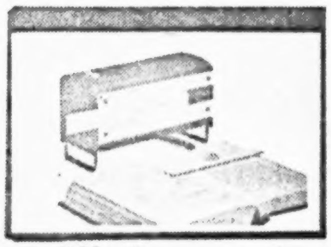
63 Science Research Associates

READING PACERS

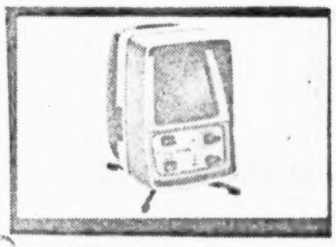
3. Optical Scanners for individual use[1]



(64) Anirama



(65) AV Research

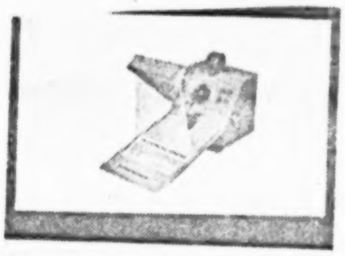


(66) Craig Research

(67) Craig Research

(68) Educational Development Labs

(69) Lafayette Instrument Co,



(70) Psychotechnics

(71) Reading Trainer

---

[1] Sometimes useable for small groups.

rate so that, by gradually increasing the pace, the reader will learn to read faster. The Tachistoscope flashes words, objects, and groups of words or objects on the screen for a fraction of a second in an effort to develop rapid recognition and heighten understanding. Reading pacers for group use are available from Educational Development Laboratories (Figure 59) and Perceptual Development Laboratories (Figure 60). Tachistoscopic units are available from Better Reading Programs (Figure 53), Educational Development Laboratories (Figure 54), Graflex (Figure 55), Keystone (Figure 56), Lafayette Instruments (Figure 57), and Learning Through Seeing (Figure 58).

Individual differences in rates of reading and learning have led to the development of several units for individual use. Projection type devices are available from Anirama (Figure 64), Audio-Visual Research (Figure 65), Craig Research (Figure 66 67), Educational Development Labs (Figure 68), Lafayette Instrument (Figure 69), Psychotechnics (Figure 70), and music?

Fig. 72 A variety of packages to teach reading skills are now available. This one anticipates the ~~use of~~ need for sound in teaching reading skills, but uses no other mechanical devices. ((American Institute of Reading)

Reading Trainer (Figure 71). Simple mechanical pacers which accomplish essentially the same function are available through Columbia Reading Program (Figure 61), Keystone (Figure 62), and Science Research Associates (Figure 63).

6. Desk-Top Projectors for Individual Learning.

Most of the projectors discussed so far were developed for group instruction. In recent years the problem of individual differences has received increased attention, and new methods of teaching have been introduced to help each student to achieve his utmost. Reading posts and listening corners allow students who finish their assignments early to make productive use of the extra time. It was inevitable that sooner or later filmstrip previewers and other small viewing devices should also find a place in the reading corner.

With the growing trend toward individual instruction there is a need for more viewing and listening materials and devices, to enrich learning experiences.

INDIVIDUAL VIEWING DEVICES [1]

	slides	filmstrip	front projection screen	magnifying lens	rear projection screen
~~AV-Research~~					
Buttafarri	X		X		
Camera Optics	X	X			X
DuKane		X			X
Execugraf		X			X
Karl Heitz	X	X			X
Hudson	X				X
Intercontinental	X				X
McClure		X			
Standard	X	X	X	X	
Viewlex		X		X	X

Table 12

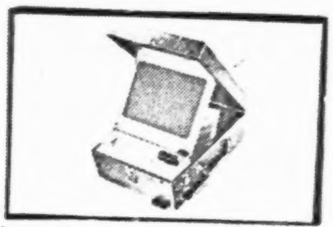
see also Sound Viewing Devices
Microfilm and Microcard Readers
Teaching Machines

---

[1] Note: slides and filmstrips cannot necessarily be used interchangeably on the machines in this section. Usually separate ~~devices are supplied~~ for these alternate media.
machines are needed

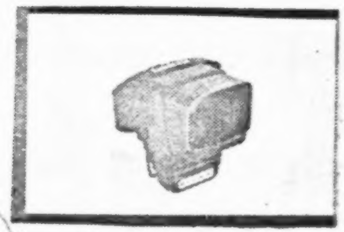
INDIVIDUAL VIEWING DEVICES

(73) Buttafarri



✓ (74) Camera Optics

✓ (75) DuKane



✓ (76) Execugraf

✓ (77) Heitz

✓ (78) Hudson

Don't Photo ✓

✓ (79) Intercontinental

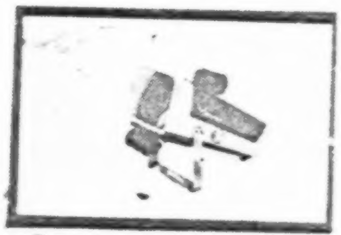
✓ (80) McClure

(81) Standard

81a

~~GET FROM PIC FILE~~ ✓

(~~82~~) Standard ✓



✓ (82) Viewlex

✓ (83) Viewlex

a. Individual Viewing Devices. The simplest viewers employ a light source behind the film and a magnifying lens. Such units are not so suited to prolonged viewing as those employing rear projection. A few of the higher power units have the dual facility of rear projection onto a built-in screen, or projecting onto a separate screen in the conventional manner. Where small rear projection screens are used, room darkening is not usually necessary.

Filmstrip previewers using a magnifying lens are made by Execugraf (Figure 76), Standard (Figure 81), and Viewlex (Figure 83). Rear screen projection allows a greater magnification, and filmstrip versions are available from Audio-Visual Research, Camera Optics (Figure 74), DuKane (Figure 75), Karl Heitz (Figure 77), and Viewlex (Figure 82, 83). Similar units for slides are available from Camera Optics[1], Hudson (Figure 78), Intercontinental Marketing (Figure 79), McClure (Figure 80), and Standard[1].

---

[1] Slide units for both Camera Optics and Standard are similar to Figures 74 and 81.

Individual
SOUND VIEWING DEVICES

	Slide	Filmstrip	35mm	16mm	magazine or cartridge load	record player	tape player	automatic advance
Anirama		X	X		X		X	X
Audio-Master		X	X			X		
Beseler		X	X		X		X	
Camera Optics		X	X			X		
DuKane		X	X			X		X
Execugraf		X	X				X	X
Gotham		X		X	X	X		X
Graflex	X	X	X		X		X	X
Gray	X		X		X	X		X
Hughes	X		X		X		X	X
Instructors Inc	X		X			X		X
LaBelle	X	X	X		X		X	
Lectron'	X		X		X		X	X
Litton	X		X		X		X	X
McClure		X	X			X		
Microcopy Inc		X		X	X	X		X
Nortronics	X		X		X		X	
Pathe		X		X	X	X		X
~~Picture Recording~~								
RCA	X		X		X		X	X
Syndial		X	X		X	X		X
Synchromat	X		X		X		X	X
U.S. Projector		X		X	X		X	X
Viewlex		X	X			X	X	

see also **Teaching Machines**

Table 13.

unde

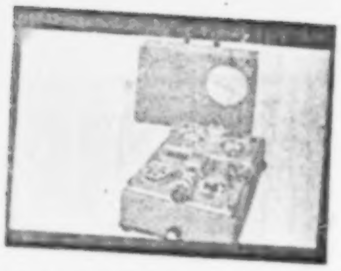
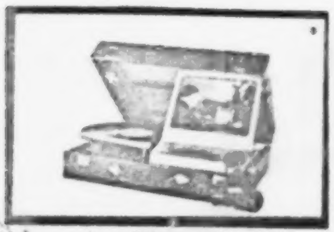


Fig. 84 Sixteen millimeter filmstrips reduce the cost of printing and transportation. This 16mm sound filmstrip projector has been supplied by the Baptista Mission for a number of years.

Jud iv.

SOUND VIEWERS FOR SLIDES AND FILMSTRIPS

(85) Anirama



(86) Audio-Master

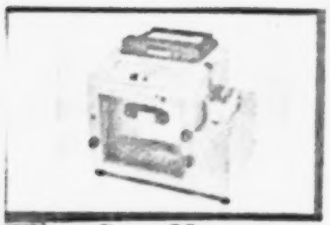
(87) Beseler

(88) Camera Optics

(89) DuKane

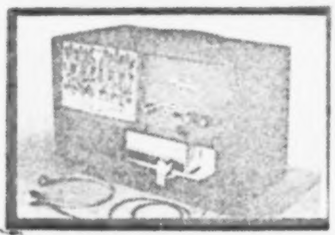
(90) Execugraf

(91) Gotham



(92) Graflex

(93) Gray



(94) Hughes

~~REPEAT (39)~~

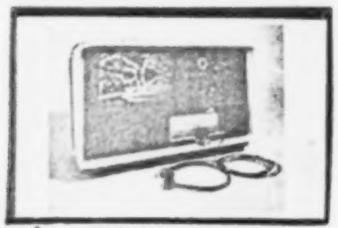
94a

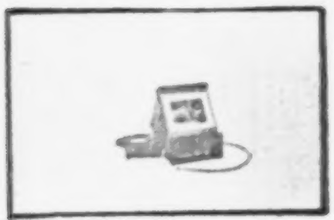
( ) Instructors Inc

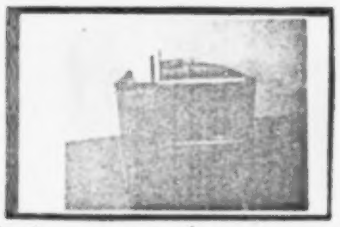
m (95) LaBelle

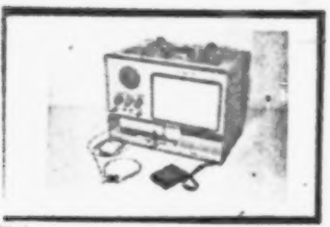
SOUND VIEWERS FOR SLIDES AND FILMSTRIPS (2)

(96) Lectron


(97) Litton


(98) McClure


(99) Microcopy Inc

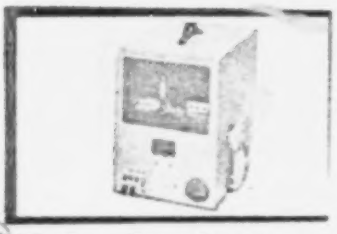

(100) Nortronics

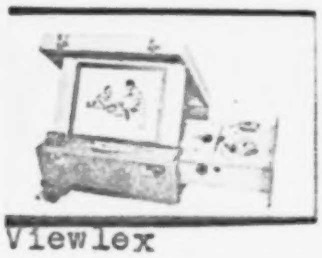
(101) Pathe

(102) Radio Corporation (RCA)

102a
Soundial

(103) Synchromat


(104) U.S. Projector Corp


(105) Viewlex

b. Individual Sound Viewers. There is a greater variety of sound-slide and sound-filmstrip units available for individual viewing than for group presentation, due in part to the use of such units by salesmen, and partly to their adoption by industry as a performance aid. Some factory assembly lines have given way to individual "work stations" where the operator follows step-by-step instructions from an individual sound viewer. This technique is widely used by the electronics industry. Such performance aids in minimizing errors, and allowing workers to change from job to job with very little retraining. These devices might also be useful in education for teaching sequential tasks, and their function is in some ways related to the teaching machine.

Sound-slide presentations are comparable to motion pictures in instances where motion is not important, and provide a relatively inexpensive means of presenting complex information. Since there are 27 companies manufacturing units of this type, their individual features are summarized in Table 13.

Note that as with sound-slide and sound-filmstrip projectors for group viewing, the sound may be on records or on tape, and inaudible pulses advance the picture ~~in~~ to synchronize ~~sync~~ with the sound. A number of the units ~~for individual use~~ have cartridge load for tape, and in a few instances for filmstrips. Where 2X2 slides are used, magazine load is universal.

~~Table~~

7. Miniaturization.

Continual research has led to innovation and improvements in materials and design so that miniaturization may apply to both the materials and equipment. This is evidenced in motion pictures by the adoption of 35mm film, 16mm film, and quite recently ~~of~~ 8mm film as an educational medium. The associated projection equipment has undergone a similar reduction in size and weight, assisted by smaller projection lamps, improved ~~with simplified~~ optics, and efficient transistor amplifiers for sound. The outcome is more readily-portable equipment

TABLE 13a

SPECIAL MOUNTINGS FOR FILMSTRIPS

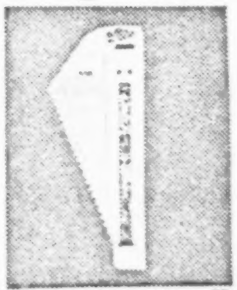
COMPANY	35mm	16mm	8mm	sound on disc	sound on tape	automatic advance	3-D
Craig	x				x *	x	
Gotham		x		x		x	
Microcopy		x		x		x	
Pathe		x		x		x	
Sawyer	x			x *			x
Sentinel	x			x			
Sundial	x			x		x	
Teaching Machines Inc			x		x *		

* optional

MOUNTED FILMSTRIPS[1]

Don
to
Photo ✓

(106) Craig Research



(107) Microcopy Inc

(108) Sentinel

Don to
Photo

(109) Teaching Machines Inc.

See also.
Gotham Fig 91
Pathe Fig 101
Sawyer Fig 133
Subadial Fig 102a

~~[1]Gotham and Pathe not shown.~~

Fig. 110 8mm sound camera. This was the first such camera to be commercially available. .(Fairchild)

Fig. 111 Using the 8mm sound projector. Cartridge loading makes the machine simple enough for a child to operate. Noise level is so low it can be used in the library.

with a reduction in cost of both films and equipment. Since filmstrips are relatively inexpensive, the advantages of miniaturization in this area are not so attractive except with individual viewing devices where the very low cost of 16mm and 8mm filmstrips gives them a great potential market. Many of the newer projectors, both motion picture and still, have adopted cartridges or similar means to simplify handling of the film. With greater portability, lower cost, and simplified handling the trend toward miniaturization is gaining momentum.

a. Transistorized Amplifiers. The advantages of transistors are discussed more fully in the chapter on sound equipment, but their impact on projector design in reducing size, weight, and power consumption deserves special mention here.

b. 8mm and 16mm Filmstrips. Although 16mm microfilm has been in use for many years, its adoption for filmstrip viewing is comparatively recent. Special methods of handling have been developed for these smaller sizes, re p.31 and 32.

PRECEDING PAGE MISSING

including plastic strips, combs, reels, and thimbles. Craig (106) and Sentinel Films (108) mount or laminate 35mm filmstrips between sheets of plastic. Gotham, ~~[illegible]~~ Microcopy, Inc (107), and Pathe ~~# #~~ use 16mm filmstrips in a plastic "comb", the teeth of ~~the comb~~ which serve to advance the filmstip one frame at a time. Recordak ~~[illegible] have~~ has developed a cardboard holder containing several strips of 16mm microfilm for use with their teaching machine. Teaching Machines Inc (109) in ~~their~~ its MultiMax teaching machine uses an 8mm filmstrip in a small plastic thimble. A number of 16mm filmstrip projectors which have been available since before 1955 use small reels, so that quite a large amount of information can be stored on a single reel. (See also microfilm equipment in chapter on photocopy processes.)

C. 8mm Sound Motion Picture Projectors. (Table 14) The weight and size of 16mm projectors, problems of threading, and the difficulties involved in ordering films through large centralized libraries ~~has~~ have caused great interest in the newly introduced 8mm sound films and projectors, ~~as a means of making films more readily available for classroom use, and~~

8mm PROJECTORS

	Regular 8mm format	modified 8mm format	cartridge load	continuous loop attachment	magnetic sound	optical sound	built in rear projection screen	optional rear projection screen available
A-16 Enterprises		X	X		X			
Agfa	X				X			
Elite	X				X			
Fairchild	X		X	X	X		X	X
Fujica	X				X			
Kodak	X				X			
Mansfield	X				X			
Maurer	X					X		
MPO Videotronics	X			X	X		X	
Nizo	X				X			
Technicolor	X							X
Vicom	X			X	X		X	

Table 14

✓

(112) A-16 Enterprises

8mm SOUND PROJECTORS

✓

(113) Agfa

✓

(114) Elite

✓

(115) Fairchild

✓

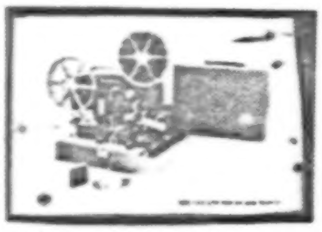
(116) Fairchild

✓

(117) Fujica

✓

(118) Kodak



✓

(119) Mansfield

✓

(120) Maurer

PIC
FILE

✓

(121) MPO Videotronics

DON
TO
PHOTO

✓

(122) Nizo

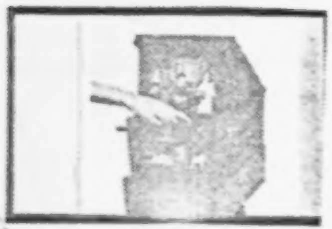
✓

(123) Technicolor

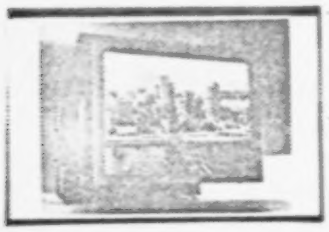
✓

(124) Technicolor

8mm SOUND PROJECTORS (2)



(125) Technicolor - box by
A-N Manufacturing Co.



(126) Vicom

~~( ) Vicom~~

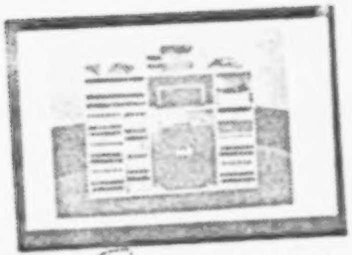


Fig. 27 Instructional Package for teaching foreign language contains 8mm sound films and an 8mm Sound Projector. (Heath DeRochemont)

The smaller film is not suited to auditorium viewing, but is more than adequate for a class of forty students. If such a tool were widely adopted, sound films would sell for about the price of library books, and every school could afford its own library of films. Also, mass production of the projectors might allow them to be reduced to the price of a phonograph! They could even be incorporated into individual viewing devices. For the moment this is only speculation; hardware and films, after all, have only recently come into existence.

Those units which are non-standard, which involve a linkage between projector and tape recorder, of which use sound "attachments" have been eliminated from this description, since they are intended primarily for home use. A number of manufacturers have adopted conventional designs which are virtually scaled down versions of their 16mm counterparts. These include Agfa (113), Elite (114), Fairchild (115), Fujica (117), Kodak (118), Mansfield (119), and Nizo (122). A number have built-in rear projection screens, including Fairchild (115), MPO Videotronics

(121), and Vicom (126). All except the Phototronics device have a screen which folds into the side of the case.

Potentially, one of the great advantages of changing to 8mm equipment is the elimination of threading through the use of self-threading cartridges. The Technicolor (123) silent 8mm projector represents the first breakthrough in this area, and rear projection boxes have already been developed for individual viewing (125) and group viewing (124). Fairchild (116) ~~have~~ has made the most important breakthrough by perfecting a continuous loop type sound cartridge for 8mm film, ~~sound film, using the continuous loop type,~~ which is completely self threading. This unit is very portable and has a small rear projection screen. A model with a larger viewing screen is being developed for classroom use. A third company, A-16 enterprises (112) has a self-threading cartridge load 8mm sound projector under development, and there will probably be a proliferation of such devices over the next two years.

For the moment 8mm projectors use magnetic sound, but the feasibility of optical sound, with its lower print cost, has been demonstrated by Maurer (120). Magnetic sound allows the user the option of preparing his own sound tracks, but optical sound reduces the cost of prints. Representatives of education and industry will need to decide whether to adopt one or both methods.

H. Multiple-Screen Presentation

A number of very elaborate projection systems have been developed for the military where several projectors and screens are used simultaneously. These usually feature rear projection, remote control, random access, and in some instances, computer-generated displays. Visual comparison is greatly facilitated by the use of two screens side by side, a technique which demands more attention from the viewer. Relationships can be clarified by juxtaposing slides and charts in this way. The simplest of these units, manufactured by Teleprompter, (129), employs

RUP

Fig. (128) Three-screen display
for teaching humanities -
University of Wisconsin. The
sequence is programmed onto
a punched tape in advance. The
instructor (left)cues the ~~[illegible]~~
next image, when he is ready.
or series of images
(Teleprompter)

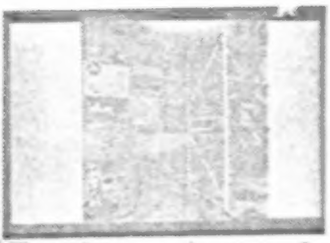
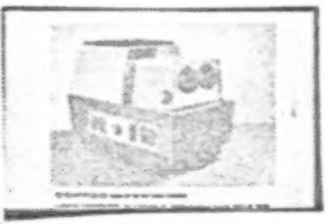


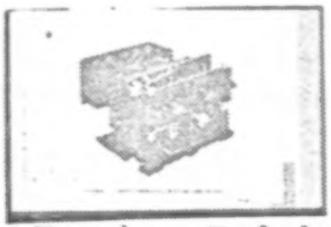
Fig. (129) Equipment used in
Teleprompter installation
above. Conventional projection
equipment faces onto a rear
projection screen. The ~~[illegible]~~
automatic sequencing device is
on the left.

THREE DIMENSIONAL VIEWERS AND PROJECTORS

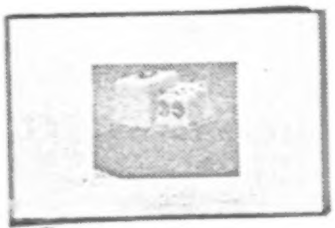
Music



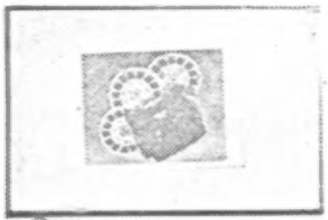
(130) Compco



(131) Fenske, Fedrick, and Miller



(132) Sawyer



(133) Sawyer

conventional film and television projectors with a ~~projection equipment and~~ large rear projection screen. Figure 128 shows a three-screen unit now in operation at the University of Wisconsin. A small punch card programmer serves to start and stop the equipment at the appropriate times, or on a given cue from the lecturer. Fenske, Fedrick, and Miller have developed a tracing board to introduce graphic materials and writing directly over a large screen display. Although this system uses only one screen in any one room, it can accept servo-projectors to reproduce the performance in ~~other~~ adjacent rooms. ~~as well~~. Also, since the writing projector is part of a dual projector (Fig. 131) it can be used for three-dimensional projection by the addition of polaroid~~s.~~ filters. Figures 134, 135, and 136 show how this system might be used in several classrooms simultaneously. The equipment can also be joined with a computer for the production of computer generated displays.

~~Fig.~~

~~Figs.~~

Fig. 134 The Knowledge Box. Multiple projectors illuminate the four walls, ceiling, and floor in an attempt to "saturate" the viewer with information. The communication aspects are being studied by Isaacs at the Illinois Institute of Technology.

Fig. 135 Projectors mounted on one outside wall of "The Knowledge Box."

135a — Aeronutronic

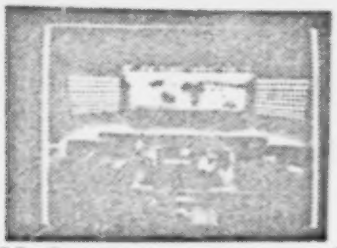


Fig. 136 Large screen display used for tracking the Astronauts. (General Dynamics)

136 a, b, c.
Fenske, Fedrich
+ Miller.

Computers allow storage and processing of data in digital form, with the rapid generation of displays. Mathematical formulas, ~~can be converted into graphic displays,~~ weather data, or tactical data on a battlefield situation, can be plotted graphically in a matter of seconds after receiving the information. The more complex systems generate displays in a variety of colors, and simultaneously produce duplicates ~~bring up a display on several~~ for remote viewing screens. ~~simultaneously.~~ These highly complex computerized systems are used only for military purposes at the present time, including such activities as briefings, teaching and training, war gaming ~~by the simulation of tactical problems using a computer,~~ and potentially, for actual battlefield situations. Their ability to accurately display up-to-the-minute information makes them an important strategic tool. The recent Astronaut flights were tracked minute by minute using giant displays of this type. See Figure 136.

~~Computerised display systems using~~ Large screen display~~s~~ systems have been developed by Aeronutronics, DuMont, General ~~Precision~~ Dynamics ~~[illegible]~~, Informatics ~~[illegible]~~, Marquardt ~~[illegible]~~, ~~National Cash Register [illegible]~~, and Radio Corporation of America ~~[illegible]~~. Most of these systems have ~~[illegible]~~ individual ~~advantages qualities~~ features which are too numerous and too complex to be discussed here. They represent the ultimate in present projection systems, and ~~no doubt some~~ they will doubtlessly ~~ultimately~~ exert influence on future ~~of their less costly features will [illegible] filter down to~~ projection systems at the college and public school level. Consider these possibilities: ~~It is possible to~~ The instructor can write or type directly on the screen with greater clarity than ~~either~~ with either a chalkboard or an overhead projector; graphic materials can be produced almost instantaneously, and stored for later use; pictures and graphic materials in regular use can be stored in large random access projectors so that a whole range of materials, pictorial and verbal, are instantly available as required.

I. Three-Dimensional Viewing.

Schools have never used three-dimensional viewing to any extent, probably because the equipment and relevent materials have never been available in any quantity.. It would seem that there are a number of subjects in the curriculum where dimensional understanding is necessary, and where three-dimensional viewing devices might be used to advantage. These could be simple individual viewers of the type manufactured by Sawyer (133), or projection devices such as those by Compco (130) and Sawyer (132), which require the viewer to wear polaroid glasses. Vectograph film will shortly enable three dimensional images to be projected on any existing projector, but it will still be necessary for the student to use special glasses for viewing.

C. 1963-1970: A LOOK INTO THE FUTURE

It is expected that many of the existing trends will continue. There will be increasing use of individual instruction using simple rear projection viewers, often with synchronized sound. There will be bigger and brighter screens for those who need them, and a growing use of multiple screen techniques. Equipment will become even more flexible and simpler to operate. Image and sound quality will continue to improve.

New discoveries and innovation will introduce new image recording materials (see chapter on photocopy processes), while fiber optics and fluorescent screens which retain images may lead to the development of some new devices or media which cannot presently be envisioned. A few specific areas of development might be as follows:

1. Optics. The anamorphic lens has been with us for many years, and has been used in theatres for Cinemascope films since 1954. So far there is no indication of any educational values except for a very few special applications. If wider screens are

it will probably be for multiple images.

Fiber optics is a relatively new field which might well have something to contribute. Using hair-like glass fibers as efficient light transmitters, this technique allows an image printed or projected onto one end of a bundle of fibers to be reconstituted at the other end, so long as the fibers are arranged in identical pattern. Tapered fibers can reduce or magnify images, and might one day replace conventional lens systems for some applications. Also, images can be "piped" around corners, in a manner not possible with mirrors and lenses.

2. New Uses. The current use of microfilm to reduce storage, and the trend toward computerized library operations will lead to increasing use of microfilm viewers as compared to books. Perhaps one day their use will increase to the extent that it is more convenient (as well as much less costly) to have photo-duplication in the form of microfilm or micro-cards, rather than printing ~~[illegible]~~ full-size paper copy. The use of films which are erasable and re-useable might make this approach particularly attractive, and ~~[illegible]~~ if viewing units can be made so inexpensive that every student would have one as part of his study equipment.

3. 3-D Processes. The Polaroid Corporation predicts that it will soon be possible to make 3-D pictures in color which can be projected by an ordinary projector. ~~[illegible] requiring the viewer only to wear polaroid glasses.~~ The use of regular projectors without modification is attractive since this eliminates the problem of registering ~~[illegible]~~ dual images ~~[illegible]~~ on the screen, ~~[illegible]~~ and the physiological dis-

KUP

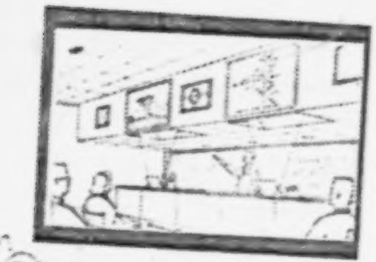


Fig. 137 Sketch suggesting how projection devices might be used in the future classroom.

(Caudill)

comfort of jittering ~~[illegible]~~ registration ~~[illegible]~~ from dual motion picture projectors, ~~[illegible]~~.

4. Controlled Readers. The addition of synchronized sound to controlled reading devices promises to make them ~~very~~ much more effective in accelerating reading speed and in training ~~be~~ very young students in good reading habits. ~~[illegible]~~

5. Individual Study Booths. Most teachers ~~envision~~ anticipate ~~[illegible]~~ more provision for individual study in the school of the future. It is expected that ~~these~~ schools will, in many cases, be equipped with simple viewing and listening devices.

6. Automation. Means of synchronizing multiple screen presentations, of producing graphic displays, and of achieving random access to stored materials will greatly simplify the location, ~~and~~ selection, ~~or~~ and preparation of materials.

7. Rea~~t~~r Screens. Rear projection will become even more common than the use of reflecting screens.

A-16 Enterprises
3008 Verdugo Drive
Los Angeles 65, California

Aeronutronic Division
Ford Motor Company
Ford Road
Newport Beach, Califonnia

Agfa, Incorporated
516 West 34th St.
New York 1, N.Y.

American Optical Company
Instrument Division
Buffalo 15, New York

American Institute of Reading, Inc.
1725 Beverly Blvd.
Los Angeles, 26, Calif.

American Magnetic Film Striping Corp.
156 Fifth Ave.
New York 10, N.Y.

The Anirama Company
385 East Green Street
Pasadena, Calif.

A-N Manufacturing Company Inc.
Videomaster Division
1308 S. Pulaski Road
Chicago 23, Illinois

Argus Cameras, Inc.
405 Fourth St.
Ann Arbor, Mich.

Audio Devices, Inc.
444 Madison Ave.
New York 22, New York

Audio-Master Corporation
17 East 45th Street
New York 17, N.Y.

Audio Visual Research
523 S. Plymouth Court
Chicago 5, Ill.

~~Avaccord~~ AVACO
1017 ELM ST.
WINNETKA, ILLINOIS

C. O. Baptista Mission
434 Sunnyside Avenue
Wheaton, Illinois

Bausch & Lomb, Inc.
635 St. Paul St.,
Rochester 2, N. Y.

Bell & Howell Photo Sales Co.
7100 McCormick Rd.
Chicago 45, Ill.

Charles Beseler Company
219 S. 18th Street
East Orange, New Jersey .

Bauer - (see ~~Camera~~ Equipment Co

Better Reading Programs, Inc.
230 East Ohio Street
Chicago, Ill.

Bi-Fi, Inc.,
Drawer 5248
1420 N.E. 3rd.,
Amarillo, Texas

Blonder Tongue Laboratories
9 Alling Street
Newark, N.J.

Book of the Month Club, Inc.
345 Hudson Street
New York 14, New York

Brereton, Grover and Company
400 East 20th Ave.
Denver 5, Colo.

Dr. Burke's Reading Clinic
615 Middlefield Road
Palo Alto, Calif.

Burleigh Brooks, Inc.
420 Grand Ave.
Englewood, N.J.

~~Burtek, Inc.~~
~~7041 E. 15th~~ St.
~~Tulsa, Okla.~~

Buhl Optical Co.
1009 Beech Ave.
Pittsburgh 33, Penn.

Busch Film and Equipment Co.,
214 South Hamilton Street,
Saginaw, Mich.

Buttafarri Corp.
452 Fifth Ave.
New York 18, New York

Columbia Reading Program
(See Book of the Month Club)

Camera Equipment Co., Inc.
315 W. 43rd St.
New York 36, N. Y.

Camera Optics Manufacturing Corp.
37-19 32rd. Ave.
Long Island City 5, New York

Caudill, Rowlett, + Scott,
Architects

Compco Corporation
1800 N. Spaulding Avenue
Chicago 47, Illinois

Cousino Electronics Corp.
1941 Franklin Ave.
Toledo 2, Ohio

Craig Research, Inc.
3410 South La Cienega Blvd.
Los Angeles 16, Calif.

DuKane Corp.
St. Charles, Ill.

DuMont Laboratories
750 Bloomfield Ave
Clifton, N.J.

T. Gerald Dyar
P.O. Box 12
Elmwood 10, Connecticut

Eastman Kodak Co.
343 State St.
Rochester 4, N.Y.

Educational Development Laboratories
284 East Pulaski Road
Huntington, New York

Elba Corp.
1017 Pearl Street
Boulder, Colo.

Elite - see Tanberg

Elmco Co., Ltd.
855 Ave. of the Americas
New York 1, N.Y.

The Execugraf Corp.
1001 North Orange Drive
Hollywood 38, Calif.

4

Fairchild Camera and Instrument Corp.
Industrial Products Div.
580 Midland Ave.
Yonkers, N.Y.

Fenske, Fedrick, and Miller Inc.
12820 Panama Street
Los Angeles 66, California

Fuji Photo Optical Products, Inc.
111 Fifth Ave.
New York 3, New York

Fujica (see Fuji Photo Optical Products, Inc.)

General Dynamics/Electronics
3302 Pacific Highway
San Diego, Calif.

General Electric Co
Electronics Park
Syracuse 1, N.Y.

Genesee Tool & Die Corporation
99 Mt. Hope Avenue
Rochester 20, N.Y.

B R. Gilbert and Associates
Box 324
Woodland Hills, Calif.

Gotham Recording Corp.
2 West 46th Street
New York 36, New York

Graflex, Inc.
3750 Monroe Ave.
Rochester 3, New York

Gray Manufacturing Company
Special Products Division
16 Arbor Street
Hartford, Conn.

The Harwald Company
1245 Chicago Ave.,
Evanston, Ill.

Heath De Rochemont Corporation
16 Arlington St.
Boston 16, Mass.

Karl Heitz, Inc.
480 Lexington Ave.,
New York 17, N. Y.

Hoover Brothers, Inc.
1305 North 14th Street,
Temple, Texas

Hudson Photographic Industries, Inc.
Irvington-on-Hudson, N. Y.

Hughes Aircraft Company
Videosonic Systems Division
P.O. Box 3310,
Fullerton, California

Informatics, Inc.
8535 Warner Dr.
Culver City, Calif.

Instructors, Inc.
P. O. Box 2065
Palos Verdes Peninsula, Calif.

Intercontinental Marketing
a division of Interphoto Corp.
45-17 ~~Rxxx~~ Pearson St.
Long Island City 1, New York

International Business Machines (see Science Research Assoc.)

Kalart-Victor (see Victor)

Keystone View Company
Meadville, Pa.
A subsidiary of Mast Development Co., Inc.

Kodak (see Eastman Kodak)

La Belle Industries
8545 Academy Station
Albany, New York

Lafayette Instrument Co.
North 26th Street and 52 By-Pass
Lafayette, Indiana

Learning Through Seeing, Inc.
P.O. Box 368
Sunland, Calif.

Lectron Corp. of America
9929 W. Silver ~~Sping~~ Spring Drive
Milwaukee 18, Wisconsin

Lester Dine
102 Jericho Turnpike
Floral Park, Long Island, New York

Litton Industries, Inc.
336 N. Foothill Road
Beverly Hills, Calif.

LW Photo, Inc.
P. O. Box 147
18220 Parthenia St.
Northridge, California

Mansfield Industries Inc
1227 W. Loyola St, Chicago 26, Illinois

Marquardt, Corp.
16555 Saticoy St.
Van Nuys, Calif.

Mast Development Co. Inc
2212 E. 12th Street
Davenport, Iowa

see also Keystone View Co.

J. A. Maurer Inc
37-01 31st St
Long Island City 1, N.Y.

McClure Projectors, Inc.
1012 Church Street
P.O. Box 1338
Evanston, Ill.

Microcopy Inc.
3808 West 54th Street
Los Angeles 43, Calif.

Minnesota Mining & Manufacturing, Co.
(see Revere Camera Co.)

Movie Mite Corp.
8811 Puritan Ave.
Detroit 38, Mich.

– MPO Videotronics Inc
222 E. 44th St.
New York 17, N.Y.

Nichols, Johnson and Bridge, Inc.
P.O. Box 822
Boulder Colo.

Nizo - see Burleigh Brooks

Nortronics Division, Northrop Corporation
222 N. Prarie Avenue
Hawthorne, California

Pathe - see Richards Musical Instruments
Not

Perceptoscope (see Perceptual Development Labs)

Perceptual Development Laboratories
6767 Southwest Avenue
St Louis 17, Missouri

Pictronics, Corporation
236 E. 46th Street
New York 17, N.Y.

Polaroid Corp.
Cambridge 39, Mass

Psychotechnics, Inc.
105 West Adams Street
Chicago 3, Ill.

Radio Corporation of America
Camden 2, New Jersey

Ralke Co Inc.
649 N. Highland, Hollywood, Calif.

The Reading Laboratory, Inc.
500 Fifth Ave.
New York 36, New York

Reading Trainer
5811 Riverview Blvd.
St Louis 21, Mo.

Readwell Laboratories, Inc.
1922 Bonita Ave.
Berkeley, Calif

Revere Camera Co.
2501 Hudson Rd.
St. Paul 19, Minn.

Subsidiary of Minn. Mining & Manufacturing, Co.

Richards Musical Instruments
Melrose Park, Illinois
, ~~Indiana~~

Sawyer's, Inc.
P.O. Box 490
Portland, Ore.

Science Research Associates
259 East Erie Street.
Chicago, 11, Ill.

A Subsidiary of IBM

Sentinel Films
1139 Cadiz Drive
Simi, Calif.

Spindler & Sauppe, Inc.
2201 Beverly Blvd.
Los Angeles 57, California

~~SRA - A subsidiary of IBM)~~

Standard Projector and Equipment Co., Inc.
7433 North Harlem
Chicago 48, Ill.

Staples-Hoppmann, Inc.,
3240 Duke Street,
Alexandria, Va.

Sundial Services Inc.
13812 Ventura Blvd
Sherman Oaks, Calif.

Synchromat Equipment Corporation
619 Liberty
Jackson, Michigan

Tanberg of America, Inc.
8 Third Ave.
Pelham, N.Y.

Teaching Machines, Inc.
235 San Pedro NE
Albuquerque, New Mexico

Technicolor Corporation
6311 Romaine Street
Hollywood 38, California

Technifax
195 Appleton St
Holyoke, Mass.

Telcan - see

Teleprompter Corporation
50 W. 44th Street
New York 36, N.Y.

Television Associates of Indiana, Inc
E. Barber Ave.,
Michigan City, Ind.

Titmus Optical Co.
Petersburg, Virginia

U.S Projector Corporation
Federal Way
Washington.

Vicom, Inc.
70 Alberthaw Rd.
Rochester 10, N.Y.

Victor Animatograph Corp.
a division of Kalart
Plainville, Conn.

Viewlex, Inc.
Holbrook
Long Island, New York

Visutronics Corporation
323 Las Vegas Blvd., So.
Las Vegas, Nevada

Weinberg-Watson - see Genassee Tool & Die